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ABSTRACT

The Center for Applied Research and Educational Improvement at the University of Minnesota has been working with SciMathMN to conduct a multi-year study of the implementation and impact of standards-based mathematics curricula in Minnesota in several district settings. Phase 1 of the study began in fall 2000 and continued through the 2000-2001 school year. The focus of this phase was the curriculum adoption process and the early implementation of these curricula. Eight Minnesota school districts, each of which has adopted a standards-based mathematics curriculum, participated in the study. Within each district, two schools served as case study sites. District profiles were prepared based on information from interviews with district and building staff, a survey of all implementing teachers of mathematics (n=437), and observation in 30 selected classrooms. Key findings are grouped into these areas: (1) curriculum review and adoption process; (2) early implementation processes; (3) attitudes, behaviors, and instructional practices of implementing teachers; and (4) student experiences. The most obvious finding from the study is that the implementation process is a process and not an event. The deep changes required by implementing teachers require sustained opportunities for independent and interdependent learning. Findings also suggest that it would be premature to launch an impact study until it is certain that the standards-based curriculum has been even moderately implemented. The study team recommends deferral of the second phase of the study. Six appendixes contain discussions of study methods, survey findings, and references. (Contains 9 tables and 26 references.) (SLD)

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Charting a New Course:
A Study of the Adoption and Implementation of Standards-Based Mathematics Curricula in Eight Minnesota School Districts

Final Report to
Sci Math^{MN}
Fall 2001

TM033753

Prepared by:

Center for Applied Research and Educational Improvement
College of Education and Human Development
University of Minnesota

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Acknowledgements

This study was commissioned and funded by SciMath^{MN}. The final report includes findings that are based on the review of the relevant literature related to standards-based mathematics curricula, curriculum adoptions and implementations, and the professional development of teachers. Information and data was also gathered through in-depth individual interviews with school district personnel, a teacher survey and classroom observations.

This report was written by Michael Michlin, Patricia Seppanen, and Timothy Sheldon. In particular we wish to acknowledge other members of the study team who played invaluable roles. Gayle Zoffer and Lesa Covington-Clarkson participated in the design of the study and data collection but left for other positions before the report was written. Lucy Payne provided expertise in instrument design and mathematics education and Shelley Mann provided expertise in data reduction and analysis. Rebecca Broback provided valuable data verification and editorial assistance in assembling this report.

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Executive Summary

Across the state of Minnesota, school districts have adopted a variety of new mathematics curricula developed in the 1990s with the support of the National Science Foundation. As of spring 2000, more than 100 districts in Minnesota were using one of these standards-based curricula at the elementary, middle and/or high school levels.

The Center for Applied Research and Educational Improvement (CAREI) at the University of Minnesota has been working with SciMath^{MN} to conduct a multi-year study of the implementation and impact of standards-based curricula in Minnesota in several district settings. The overarching questions for the study include:

- What implementation strategies support successful use of these curricula and positive changes in teacher knowledge and practice in different types of district contexts?
- What impact do these curricula have on students?

Phase one of the study was launched in the fall of 2000 and continued through the 2000-01 school year. Key questions addressed during this phase focused on the characteristics of (a) the curriculum adoption process, and (b) the early implementation of these curricula.

Eight Minnesota school districts—representing urban, suburban, small town, and rural settings—agreed to participate in this first phase. Each participating district has adopted a standards-based mathematics curriculum in at least two of the three grade level groups (elementary, middle, and/or high school). Within each district, two school buildings served as case study sites.

During the 2000-01 school year, the CAREI study team conducted fall and spring site visits to each district. District profiles were written—based on information collected through interviews with district and building staff, a survey of all implementing teachers of mathematics, and observations in selected classrooms.

SciMath^{MN} and the Minnesota Department of Children, Families & Learning expect to use study findings to promote policies that will support school districts in their efforts to select, implement, and sustain standards-based mathematics curricula. The research is also intended to begin to address many of the questions that parents, teachers, and school administrators have regarding the impact of these curricula on student achievement.

Key findings that emerged from our analyses of the experiences of these eight study districts may be summarized as follows.

Findings Related to Curriculum Review and Adoption Processes

- Curriculum review and adoption processes that result in the adoption of a standards-based mathematics curriculum appear to include some common steps (e.g., creation of committees, examination of materials, visits to implementing sites, and decision making at the site level). As designed these processes may not lead to a consensus among all teachers of mathematics regarding the need to adopt this type of curriculum.

- In each of the study districts it appears that a central office administrator—the superintendent or a curriculum coordinator or director has been a strong advocate for the adoption of a standards-based mathematics curriculum. The role of school principals, however, is less clear and without their support, implementation may be hindered.

- Parents, school boards, and community members, at least in the study districts, did not appear to play an active role in the curriculum review and adoption process. Their lack of active participation, at this stage, does not appear to have adversely affected a decision to consider and adopt a standards-based curriculum.

Findings Related to Early Implementation Processes

- District training plans are typically focused on successfully launching the curriculum but may not consider the long-term follow-up professional development and support (e.g., independent learning opportunities, coaching, support groups, study groups, peer-observation and feedback, etc.) that teachers need to achieve full implementation in three to five years or even longer.

- The importance of school principals, special education teachers, and other resource personnel to the successful implementation of a standards-based curriculum is often being overlooked. As a result these personnel are not consistently included in training and professional development activities.

- Implementing teachers report some common issues that they need assistance and support: coping with possible inadequacies in the curriculum related to the needs of particular types of students (e.g., students who have limited English proficiency, are poor readers, or students with special needs), the development of classroom-based strategies for assessing student achievement and mastery, or guidance on how and when to address particular skills or topics not covered in the curriculum.

- Teachers report that the adoption and implementation of a standards-based curriculum affects parents who may not understand the need for this change or how they can support their son or daughter. In selected study sites we see attention to the needs of parents, including the use of open houses focusing on the new curriculum, periodic newsletters, and group meetings as part of fall parental conferences. Many teacher respondents point out, however, that parents continue to need information and support in order to maintain a "comfort level" with the change.

Findings Related to Implementing Teacher Attitudes, Behaviors, and Instructional Practices

- In all of the study districts, implementing teachers report that the new curriculum requires a massive shift in thinking and behaving on their part. While they report they are making significant changes in their teaching practices, many teachers report they are continuing to supplement their instruction heavily with another, more traditional mathematics curriculum. Data from a small number of classroom observations across the districts, indicate that on average, implementing teachers are at the early stages of changing their instructional practices. Findings about the attitudes of implementing teachers and the current status of their instructional practices should be looked at as baseline findings. Given that a majority of the study districts are at the very early stages of implementation, we are encouraged by these findings. At the same time, the findings are a clear signal that continued professional development and support is needed by teachers to successfully transform their classroom practices.

Findings Related to Students

- Anecdotal findings regarding student experiences during early implementation highlight the fact that moving from more traditional mathematics instruction to standards-based instruction may affect students differentially. For some students the change is welcomed after some initial adjustment; for others the change may be stress producing

- Teachers' impressions regarding the early impact of these curricula on their students point at a number of outcome areas that might be assessed during the second phase of this study:

  - On-task classroom behavior;
  - Self-confidence and attitudes toward mathematics;
  - Course taking patterns;
  - Knowledge acquisition rates;
  - Performance on activities requiring higher order thinking skills and reasoning;
  - Understanding of mathematical concepts.

Conclusions and Implications

The study districts and sites represent examples of successful standards-based mathematics curriculum adoptions. As would be expected, teachers of mathematics in these school sites are at the beginning stages of implementation and continue to need support to transform their teaching practice. District administrators across the study sites, however, are to varying degrees providing the necessary time, resources, and support structures to facilitate the necessary deep changes in teacher attitudes, knowledge, and behaviors.

The most obvious implication has already been stated—the implementation process is just that, a process, not an event. The deep changes required by implementing teachers requires sustained opportunities for independent and interdependent learning. Another key implication related to the quest for data on the impact of standards-based curricula on student achievement is that until we can establish that a standards-based curriculum is being even moderately implemented in a sample of Minnesota districts and school sites, it is premature to launch an impact study.

The CAREI study team, therefore, recommends that phase two of this study, focused on an assessment of student outcomes, be deferred until the implementation of standards-based mathematics curricula by teachers reaches a targeted level. Work in the coming year might focus on a number of areas related to implementation and an evaluation of changes in student performance:

- Additional in-depth study of classroom practices of implementing teachers in a sample of districts during 2001-02 in anticipation of partnering with districts in which at least moderate implementation has been established schoolwide.

- The refinement of a set of instruments (e.g., a teacher questionnaire, district checklist to assess strategies being used to support implementation by teachers, an observation protocol to assess changes in classroom practices) to track the implementation status of a standards-based curriculum that could be used by SciMath^{MN} in their work with other Minnesota districts.

- The specification of a core set of student outcomes and the theoretical basis for each, including the identification and review of instruments and other sources of data (e.g., Minnesota's statewide mathematics assessments and standardized student assessments commonly being used in Minnesota districts) to determine their adequacy as measures of these outcomes.

I. Introduction

Across the state of Minnesota, school districts are adopting a variety of new mathematics curricula developed in the 1990s with the support of the National Science Foundation. As of spring 2000, more than 100 districts in Minnesota were using one of these standards-based curricula at the elementary, middle and/or high school levels.

The push for reform of mathematics teaching and learning is based on a growing perception that American students have become increasingly less capable of competing in the global classroom and market place. According to the National Science Foundation (no date):

> *Science and technology are bringing about dramatic changes in American society. In an increasingly technology-oriented society, a basic understanding of science and mathematics is essential to maintain a population prepared to meet the need for a technically competent workforce and to exercise the responsibilities of citizenship in a modern democracy. . . . More effective education and human resources initiatives are necessary if the U.S. is to maintain its technological leadership in the world marketplace.*

A fundamental assumption underlying much of the curriculum in America's schools is that certain skills are "basic" and must be mastered before students receive instruction on more "advanced" skills, such as mathematical reasoning (Means & Knapp, 1991). Findings from the National Assessment of Educational Progress and other research programs have consistently documented, however, that a heavy emphasis on computation—one of the basic skills—may be misplaced (Dossey, Mullis, Linquist, & Chambers, 1988). Results from the Third International Mathematics and Science Study in 1995 suggest that even America's most talented students did not compare favorably with students in other industrialized nations. The National Education Goals Panel reports that student performance in Minnesota generally parallels America's overall performance in mathematics. It goes on to say that, "The mathematics curriculum in Minnesota was and continues to be textbook based. . . . Since the mathematics curriculum tends to be textbook driven, and the textbooks promoted a 'back to basics' philosophy, Minnesota schools reflected that as well" (Minnesota & TIMSS, 2000, pp. 82 & 85). The panel claims that when the tests were administered in 1995, mathematics instruction would have been 80 percent algorithmic and 20 percent conceptual. Research by Peterson, Fennema, and Carpenter (1991) led them to conclude that although children in the United States can demonstrate computational skills at a reasonable level of proficiency, most children do not appear to understand the mathematics in the skills, and they cannot apply the skills even to simple problem situations.

It was in this context that the National Council of Teachers of Mathematics (1989) and the Mathematical Science Educational Board of the National Research Council (1989) proposed that problem solving and the development of mathematical understanding should be the foci of the mathematics curriculum for all students and that problem solving should be integrated throughout the mathematics curriculum rather than tacked on after computational skills are mastered. The National Science Foundation funded the development of 13 mathematics curricula in the early 1990s with the purpose of meeting the goals put forth by the National Council of Teachers of Mathematics. The Minnesota Profile of Learning was developed from the National Council of Teachers of Mathematics standards and are intentionally aligned to them.

The Center for Applied Research and Educational Improvement (CAREI) at the University of Minnesota has been working with SciMath^{MN} to conduct a multi-year study of the implementation and impact of standards-based curricula in Minnesota in several district settings. The overarching questions for the study include:

- What implementation strategies support successful use of these curricula and positive changes in teacher knowledge and practice in different type of district contexts?
- What impact do these curricula have on students?

Phase one of the study was launched in the fall of 2000 and continued through the 2000-01 school year. Key questions addressed during this phase focused on the characteristics of (a) the curriculum adoption process, and (b) the early implementation of these curricula.

Eight Minnesota school districts—representing urban, suburban, small town, and rural settings—agreed to participate in this first phase. Each participating district has adopted a standards-based mathematics curriculum in at least two of the three grade level groups (elementary, middle, and/or high school). Within each district, two school buildings served as case study sites.

During the 2000-01 school year, the CAREI study team conducted fall and spring site visits to each district. District profiles were written—based on information collected through interviews with district and building staff, a survey of all implementing teachers of mathematics, and observations in selected classrooms. A full description of the study design, including characteristics of the participating school districts is included in Appendix A.

SciMath^{MN} and the Minnesota Department of Children, Families & Learning expect to use study findings to promote policies that will support school districts in their efforts to select, implement, and sustain standards-based mathematics curricula. The research is also intended to begin to address many of the questions that parents, teachers, and school administrators have regarding the impact of these curricula on student achievement.

The remainder of this report is organized by major topics raised in the guiding evaluation questions:

- Section II presents key themes from a review of the literature related to curriculum reform, program implementation, professional development as a change strategy, and the assessment of teacher classroom practices;
- Sections III summarizes the key characteristics of the mathematics curriculum review and adoption strategies used in the study districts and school sites;
- Section IV highlights common district and school site implementation strategies;
- Section V presents baseline information regarding the attitudes and instructional practices of teachers implementing standards-based mathematics curricula;
- Section VI briefly summarizes the impressions of implementing teachers regarding student experiences during early implementation of these curricula;
- Section VII integrates the findings presented in previous sections to reach conclusions regarding the major study questions.

Individual profiles that detail the experiences of each study district to date are included in Appendix B. Appendices C, D, and E present tabulated findings from the survey of teachers, classroom observations, and onsite fieldwork.

Section II: Key Themes from the Literature

In order to gain an understanding of curriculum adoption and implementation, particularly as it relates to standards-based curricula in mathematics instruction, the study team systematically reviewed available research studies and journal articles in the following areas:

- Curriculum reform, with a particular emphasis on standards-based mathematics curricula and the impact of these curricula on student performance in mathematics;
- Program implementation;
- Professional development as a strategy for individual teacher and organizational change;
- Assessment of teacher classroom practices.

The aim of this search was to identify and distill the factors that promote district curriculum adoption and implementation. Additionally we wanted to understand how and to what extent curriculum adoption and implementation processes are associated with changes in teacher attitudes and behaviors. Finally we wanted to understand how changes in teacher attitudes and behaviors contribute to changes in instructional practices.

In this section we discuss six key themes that emerged in our review of the literature:

1. The relationship between teacher knowledge and practice and student performance has been established in the research literature.
2. Findings about the effects of standards-based mathematics curricula on student achievement are just beginning to emerge and be understood.
3. Successful implementation of a curriculum reform demands the contributions and sustained attention of the entire academic community. Research on curriculum implementation has led to the identification of a set of critical elements that promote success.
4. Current teachers must dramatically change their classroom practices in order to shift from a traditional curriculum to a standards-based curriculum.
5. Policymakers generally assume that teacher attitudes, behaviors, and practices can be changed with curriculum overview sessions and single session workshops.
6. Professional development strategies vary widely but under certain conditions do have an effect on teacher practice. In almost all cases there are as many things for teachers to *unlearn* as there are complex, new things for teachers to *learn*.

The Relationship Between Teacher Knowledge and Student Performance

Teaching continues to be one of the most consistent and powerful predictors of student achievement in mathematics and science ("Before it's too late," 2000). Linda Darling-Hammond (2000), for example, has found that teacher expertise is a stronger predictor of student achievement than small schools or small classes. More specifically Wenglinsky (2000) has begun to isolate teacher inputs, professional development and classroom practices that have an impact on mathematics achievement. Measuring the impact of teacher quality on student performance, as determined by the percentage of a standardized grade level a student's test score will increase, Wenglinsky found:

- Students whose teachers majored or minored in either mathematics or mathematics education outperformed their peers by nearly 40 percent of a grade level in mathematics;
- Students whose math teachers received professional development in working with special populations outperformed their peers by more than a full grade level in mathematics;
- Students whose teachers emphasized higher-order thinking skills in the classroom outperformed their peers by about 40 percent of a grade level;
- Students who received hands-on learning experiences on a weekly basis rather than on a monthly basis in the classroom outperformed their peers by 72 percent of a grade level.

The relationship between teacher characteristics and student performance is complex. Loucks-Horsley (1999), for example, was unsuccessful in establishing a relationship between student achievement and teachers' professional development because of the presence of other unknown factors that influence student achievement. On the other hand, in an earlier study she concluded that professional development may be more significant for middle school teachers. She claims to have found a general tendency for teachers to be less prepared to teach to more challenging standards because many middle school teachers have only elementary education preparation (Loucks-Horsley, 1996).

The Relationship Between Standards-Based Mathematics Curricula and Student Performance

The effects of standards-based mathematics curricula on student performance, even if it is supported with good teacher practices, remain unclear. Studies to date have shown some contradictory indications related to student achievement. Taken as a whole, findings generally show that students using standards-based curricula are making gains in problem solving and realistic activities, although more traditional mathematics curricula continue to be associated with gains in the manipulation of symbolic language and the use of algorithms. At this time Lapan, Reys, Banes, and Reys (1998) concluded that mastering computational skills is not necessarily equal to mathematical understanding.

These researchers emphasize the fact that the perceived success of a particular mathematics curriculum depends upon the expectations that the school community has related to the performance of students in mathematics. One curriculum approach appears to promote one set of student outcomes while another approach focuses on a difference set of outcomes. For example:

- Lapan, Reys, Banes, and Reys (1998) studied the achievement of 255 sixth graders using a standards-based curriculum over the course of an academic year and found that students out performed a control group that received no standards-based education in problem solving. In fact students in the control group were much more likely to receive no credit for problem solving on a standardized test;

- Huntley (2000) concluded that Contemporary Mathematics in Context, a secondary-level standards-based mathematics curriculum, was more effective in developing a student's facility with algebraic expressions and applying them to realistic contexts, while the conventional curriculum developed skills of manipulation of symbolic expressions.

Other studies have shown that students are affected differently by a standards-based curriculum: higher achieving students benefit more while the lowest achieving students neither benefit nor are they hindered by standards-based curricula (Mayer, 1998).

Successful Curriculum Implementation

Common sense dictates that the impact of curriculum cannot be assessed until it is successfully implemented. The adoption and successful implementation of a new curriculum is, at the very least, a group effort demanding the attention and contribution of the entire academic community (Ware, 2000). According to Bay, Reys, and Reys (1999) the critical elements of a successful adoption and implementation process include:

- Administrative support. Implementation was enhanced by both the leadership and support of administrators. Administrators did not simply facilitate but promoted and enabled implementation;
- Opportunity to study. Teachers had the opportunity to study the National Council of Teachers of Mathematics standards and to align the curriculum to local standards or objectives;
- Sampling curricula. Teachers were given the opportunity to pilot and teach several curricula;
- Daily planning. Teachers need time to reflect on curriculum planning, and pacing;
- Interaction with experts. Teachers need to see and interact with "experts" using the curriculum and have the opportunity to travel beyond their own districts to observe standards-based teaching;
- Collaboration with colleagues. Teachers need time to collaborate with peers; this collaboration goes beyond teaming and planning classes together;
- Incorporating new assessments. Teachers need to recognize that new methods and means of assessment are valuable and may require significantly more time to process;
- Communicating with parents. Teachers need additional time to deal both with educating parents about the curriculum and time to respond to parent concerns;
- Helping students adjust. Teachers need to recognize that this shift is a dramatic change for students and requires deliberate planning to assist students in transition;
- Planning for adjustments. Teachers will need to provide more time to assist in coordination across grade bands .

Spillane and Zeuli (1999) have found that successful curriculum adoption and implementation typically necessitates the infusion of financial resources. In addition to funding, Spillane (1997) has found that the local school district's capacity and ability to promote policies that directly support implementation is proportional to their leaders' abilities to assimilate new ideas from external policy and professional sources and then to transmit and translate them to others in the district. For instance the most successful local school district reformers took the time to learn about specific reforms and to teach them to practitioners.

Researchers have consistently demonstrated that strong versus weak implementation has an enormous effect on the achievement of students who are being taught using a standards-based curriculum (Briars, 1999). The National Staff Development Council (1995) concluded that the change process in schools—going from initiation, to implementation, to institutionalization—is not a linear progression, "but one in which events at one phase can alter decisions made at a previous stage. . . . The time frame from initiation to institutionalization for moderately complex changes is three to five years; more complex changes . . . may take longer" (p. 19).

This suggests that it is important for an implementing district to focus both on what is implemented and an evaluation of the degree of implementation each year.

A Standards-Based Curriculum Requires Deep Changes in Current Teacher Practice

Policymakers and school leaders must recognize that significant changes in instruction and fundamental belief systems result in higher demands being placed upon teachers more than ever before. In reality the adoption and implementation of standards-based mathematics curricula require deep change of both teachers and students (Hiebert, 1999).

The demands placed upon teachers as they shift from a traditional curriculum to a standards-based curriculum involve significant stress and learning anxiety. "Standards-based mathematics education requires a considerable, consequential shift in what teachers do in the classroom and possibly a paradigm shift in their view of mathematics education" (Robinson, 2000, p. 112). Differences include changes in philosophical focus, instructional and pedagogical strategies, shifts in the choice of content, as well as the overall approach to algorithms and the use of technology.

Edgar Schein (1992), a noted theorist of organizational change, has found that individuals in organizations are motivated to change when their survival anxiety is greater than their learning anxiety—loss of competence, for example. Schein stresses that the leadership of a change effort, then, should specify goals in concrete terms regarding needed changes in behavior and facilitate the change processes by providing individuals a range of strategies to reduce their learning anxiety. The goals should be considered non-negotiable while the change process over time is managed by the learner.

Professional Development as a Change Strategy

Professional development strategies can vary widely and only under certain conditions does this approach have an affect on teacher practice. Cohen and Hill (1998), for example, have shown that professional development strategies continue to vary widely and that these variations have a significant impact on teacher practice. Cohen and Hill demonstrated that a relationship exists between the amount and method of professional development and instructional practice. Thus teachers who received professional development using a specific curriculum demonstrated more beneficial changes in instructional practice over teachers who received less targeted professional development (viz., grading and learning styles).

Ball (1996) acknowledges that while professional development is recognized as an important element of ongoing teacher development, it remains an art—uncertain as practice itself. Research on professional development, however, has isolated several components of successful processes: opportunities for experimentation, study combined with reflection, and the active engagement of the wider community (Ball, 1996; Loucks-Horsley, 1996 and 1999).

According to the National Staff Development Council (1995):

> *A growing body of research on the effectiveness of staff development programs has identified the characteristics of productive programs. The characteristics include:*
>
> - *Connectedness to school settings and to school wide efforts;*
> - *Involvement of teachers as planners;*
> - *Providing choice and differentiated learning opportunities;*
> - *Use of demonstration, supervised practice, and feedback as a part of training; and*
> - *Ongoing assistance and support.* (p. 29)

Many policymakers and school administrators, however, continue to assume that teacher behavior can be changed with curricular overview sessions and single session workshops. Researchers such as Sparks and Hirsh (1997) have argued that staff development programs should be considered a success if the instructional behavior of teachers is altered in a way that benefits students and not in terms of how many teachers and administrators participate or how they perceive its value. Joyce and Showers (1988; cited in the National Staff Development Council, 1995, page 31) have found that up to 20 follow-up and coaching sessions may be needed to ensure the successful implementation of a particular teaching strategy, and successful implementation must be achieved before one can even consider the impact of reformed teaching practices on student performance.

Implications

This preliminary review of the literature highlights three key points, each of which has important implications for this study:

- A precondition for assessing student performance centers on implementing teachers sufficiently transforming their classroom practices so that they are fully implementing a standards-based mathematics curriculum.
- School districts adopting standards-based mathematics curricula can promote full implementation by endeavoring to offer professional development opportunities that adhere to the components that have been shown by research to lead to changes in teacher attitudes, behaviors and practices. The deep changes required of teachers should not be expected in the short-term; it may take five or more years of sustained professional development and support to see school wide transformation of practice.
- The assessment of student performance should center on a set of outcomes that would logically be attributable to instruction based on a standards-based mathematics curriculum. Given the intent of a standards-based curriculum (e.g., mathematics understanding, real-world problem-solving), performance on more traditional mathematics assessments that focus on computation might not be expected to improve dramatically. These more traditional assessments may be looked to, however, to establish if a standards-based curriculum has a negative impact on the computational skills of students.

III. District and School Site Mathematics Curriculum Review and Adoption Strategies

The major force in the decision to begin a process to consider adopting new mathematics curricula is the district's administration (three-quarters of the eight sample districts). In these districts, the superintendent or the curriculum coordinator were equally likely to initiate the process. Thus, although teachers often are important players in helping decide which curriculum is adopted in their respective grade band, they rarely appear to be initiators of the process. We found one district in which teachers played such a role and one other in which they shared the role with the curriculum coordinator.

In this section we explore the events or issues that appear to have triggered the decision to initiate a curriculum review and adoption process. We present findings from the eight sample districts and 16 sample school sites regarding the duration of the review process and the most common strategies used to select a curriculum, key players who were part of the process, and issues that emerged.

Triggering Events or Issues

School districts typically review and adopt curricula by major subject area on a fairly regular cycle (i.e., every five to 10 years). Minnesota's recently adopted graduation standards and statewide assessments in mathematics might be considered other major factors that would trigger review and adoption decisions. According to district-level respondents in a majority of the eight sample districts, the decision to review and adopt a new mathematics curricula occurred because this subject area had come up in the regular curriculum review cycle. In only two cases were the graduation standards cited as a triggering force in the decision to undertake the review and adoption of new mathematics curricula, however alignment to standards can become an important criterion during the review process.

A slightly different picture, however, emerges from the survey responses of elementary and secondary teachers of mathematics from the sample districts (refer to Table 1). Retrospectively teachers most commonly cite the need to offer students a different curriculum experience that focuses on understanding and applying mathematics, followed by a need to better align the curriculum to the Minnesota Graduation Standards.

Table 1. Teacher perceptions of factors in the district's decision to adopt new curricula

	Very Important		2		Important		4		Not Important		N/A / Don't know	
	n	%	n	%	n	%	n	%	n	%	n	%
Wanting to better align our curriculum to Minnesota Graduation Standards	197	47%	83	20%	62	15%	5	1%	3	1%	67	16%
Wanting to offer students more opportunities to understand mathematics and apply it in solving real-world problems	194	47%	93	22%	63	15%	9	2%	1	0%	55	13%
Wanting to improve students' test scores in mathematics	168	40%	98	24%	74	18%	11	3%	4	1%	62	15%
Wanting to better align our curriculum to National Council of Teachers of Mathematics standards	130	31%	86	21%	89	21%	7	2%	2	0%	103	25%
Needing to adopt new materials because it was mathematics' turn in the curriculum adoption cycle	77	19%	67	16%	86	21%	56	13%	47	11%	83	20%

Source: Survey of Mathematics Teachers. Spring 2001. Center for Applied Research and Educational Improvement. University of Minnesota.

When asked to rate the importance of five potential factors in their district's decision to adopt a standards-based mathematics curriculum, more than two-thirds of the teachers rated the following factors a 1 or 2 (1 = very important, 3 = important, 5 = not important):

- Wanting to offer students more opportunities to understand mathematics and apply it in solving real-world problems (69 percent rated item a 1 or 2);
- Wanting to better align our curriculum to Minnesota Graduation Standards (67 percent rated item a 1 or 2).

As can be seen in Table 1, slightly more than a third of the teachers (35 percent) rated the curriculum adoption cycle as a major factor.

Key Elements of the Curriculum Adoption Process

Duration. The adoption process in the study districts was generally completed in one school year or less (seven of the eight districts). The eighth district operated under a unique two-year review process, including a year to articulate goals and a year to study materials.

Common strategies of district adoptions. The study districts generally relied on four strategies to review and adopt a standards-based mathematics curriculum:

- Formation of a curriculum committee(s);
- Examination of materials supplied by publishers of mathematics curricula;
- Visits to implementing classrooms in other districts;
- Decision to adopt at the school-site level.

Seven of the eight study districts established one, two or three ad hoc mathematics review committees composed entirely of teachers. One district, in contrast, used two standing committees for the mathematics review, one a committee of department chairs and interested teachers and the other a general curriculum committee composed of parents and other community residents. Most district used a single K-12 committee. And of the three districts that formed separate committees for elementary, middle, and high school study, in only one district were these three grade band committees autonomous.

Teachers from the committees used two strategies to obtain and examine possible curricula. In a few districts, they approached textbook representatives at the mathematics conferences they attended. The other strategy was to telephone textbook representatives to get materials. Most districts just looked at the new, standards-based curricula. Only one district had a clear policy of examining candidates representing both standards-based and traditional curricula, another district stipulated that a standards-based curriculum and a traditional text were to be adopted at the secondary levels.

During adoption three quarters of the districts sent teachers to already implementing districts to provide both an opportunity to discuss the curricula with teachers using the materials as well as to see what would be required of teachers implementing each curriculum. Visits varied in terms of which teachers participated, which grade levels were observed, and which curricula were observed. Additionally representatives from the publishers suggested staff in other school districts who could provide the teachers with information about using the various curricula. Staff from SciMath^{MN} and the Minnesota Department of Children, Families & Learning also assisted some adopting districts with contacts in implementing districts.

We saw little evidence of systematic data-based self-study or piloting of adopted curricula as part of the adoption process in the study districts. Only one district began the adoption process with a formal needs assessment or self-study, including surveying parents to learn of their needs and desires and undertaking a scope and sequence review. After the articulation and approval of curricular goals, a wide range of materials were studied in light of the goals. Systematic, long term, piloting was only undertaken in one district and that was fortuitous as it began well ahead of the adoption process.

The decision making process regarding whether or not to adopt a new curriculum and which one to adopt occurred in one of two ways in the study districts. One way was for the teachers on curriculum committees to make the final decisions at all grade levels, with or without the input of other teachers. In other districts, but equally often, all teachers at the grade band make the decision after the committees completed their work.

Key Players During the Review and Adoption Process

While each district appears to engage a slightly difference mix of players in the review and adoption process, we do see some basic patterns:

- School superintendents appear to have played active roles in only about half of the study districts. Superintendents typically would meet frequently with the curriculum coordinators, appoint teachers to the committees, and take on some of the PR load with regard to the need for change in the mathematics curricula.

- When a school superintendent was not a key player, the curriculum coordinator appears to have played an active role by getting teachers to agree to serve on the review committees and choose other districts and their experienced teachers for visits.

- Teachers of mathematics are consistently the most active players in helping decide which curriculum is adopted in their respective grade band, although they rarely appear to trigger the decision to initiate the curriculum review or adoption process.

The apparent lack of active involvement of a number of key players, by role, is noteworthy. While school board members and principals may have been supportive of a decision to initiate a curriculum review and adoption process, we saw little evidence of their active involvement. In most districts, responsibility for the review and adoption process was delegated to the teachers with principals and central office personnel providing logistical assistance, if only to hire substitute teachers to allow committee teachers released time to visit other district already into the implementation process.

Looking outside the school system, we saw evidence of active involvement of parents on curriculum committees, parents generally, or other interested district residents in only one study district. And here that was through their standing curriculum committee.

Given the above patterns of involvement, it can be discerned that salespeople from the curriculum publishers, by sharing and promoting their particular curriculum, and teachers from other adopting districts, who shared their experiences, perhaps exerted the most active outside influence on an adoption decision.

Teacher satisfaction with review and adoption processes. Teachers of mathematics from the study districts appear on average to be satisfied with four areas of involvement of key players, but we do see that a small proportion of them report strong dissatisfaction (refer to Table 2).

Table 2. Teacher satisfaction with aspects of the review and adoption process

	Strongly Agree		2		Neither Agree Nor Disagree		4		Strongly Disagree		N/A / Don't know	
	n	%	n	%	n	%	n	%	n	%	n	%
I received good information why the district chose our current standards-based curriculum	111	27%	160	38%	49	12%	41	10%	24	6%	33	8%
The district involved all appropriate groups and persons in the adoption decision	101	24%	121	29%	54	13%	37	9%	17	4%	88	21%
Teachers in my building had sufficient opportunity to be involved in the adoption decision	97	23%	118	28%	65	16%	36	9%	22	5%	79	19%
Teachers in my building took an active part in the adoption process	86	21%	119	28%	71	17%	44	11%	20	5%	78	19%

Source: Survey of Mathematics Teachers. Spring 2001. Center for Applied Research and Educational Improvement. University of Minnesota.

Overall 49 percent or more of the teacher respondents rated the following statements a 1 or 2 (1 = strongly agree, 3 = neither agree or disagree, 5 = strongly disagree) while 13 to 16 percent expressed disagreement by rating them a 4 or 5:

- I received good information why the district chose our current standards-based curriculum (65 percent rated item a 1 or 2; 16 percent rated item a 4 or 5);
- The district involved all appropriate groups and persons in the adoption decision (53 percent rated item a 1 or 2; 13 percent rated item a 4 or 5);
- Teachers in my building had sufficient opportunity to be involved in the adoption decision (51 percent rated item a 1 or 2; 14 percent rated item a 4 or 5);
- Teachers in my building took an active part in the adoption process (49 percent rated item a 1 or 2; 16 percent rated item a 4 or 5).

What cannot be discerned from these findings, however, is the source of the teacher dissatisfaction in terms of the involvement of all appropriate groups and persons.

Key Issues and Concerns During the Review and Adoption Phase

Any major effort to plan and support a curriculum review and adoption process will lead to problems and issues that if recognized and addressed, strengthen the effort. In retrospect respondents from the study districts identified several key issues and concerns that emerged, many of which were not initially anticipated and addressed. Their responses group into two categories: (1) issues and concerns about the planned implementation of the standards-based mathematics, and (2) concerns about the review and adoption process. Additionally we identified a number of issues that were specific to a particular grade level.

General issues and concerns about the curricula:

- Several districts traditionally grouped students by prior achievement in mathematics, and this was to be dropped in the standards-based curricula. The developers' and publishers' point is that achievement grouping is no longer necessary in the new curricula. On a similar note, teachers reported hearing concerns from parents of high achieving children in mathematics that their children would not be sufficiently challenged.

- A generalized concern was expressed that the program would be difficult for students. Thus, teachers and administrators were more hesitant about using a standards-based mathematics program with less successful students, citing especially children with special education needs, students with limited English proficiency and others who have difficulty with reading. Even though the standards-based curricula are touted as meeting the needs of students who traditionally do not excel at mathematics (e.g., students of color, students from low income families), a concern was that these students would also find it difficult.

- Teachers in particular were concerned that the new curricula lacked content coverage in certain subjects, and they foresaw the need to supplement topics. This became especially true of teachers in the elementary grades who are using supplemental materials for fact work computational skills.

- Teachers at all grade levels anticipated their own need for enhanced and ongoing training. They especially hoped for sessions after they had some experience teaching the new curricula in which their questions on methods and content could be addressed.

General issues and concerns about the adoption process:

- Many teachers of mathematics considered the decision to adopt a standards-based curriculum as a major one, deserving wider involvement in the deliberations and decision making process. In many of the study districts, however, the standard curriculum review and decision making process was used: a curriculum committee, typically consisting of a few teachers, was formed by invitation of the superintendent. Only the committee had the right to vote on the adoption.

- In several study districts the teachers at each grade band (e.g., elementary, middle, high school) were allowed to make their respective adoption decisions independently. And this leads to a lack of articulation across the grade bands.

- In some districts teachers felt that their adoption choices were limited to a selection from the most traditional of the available standards-based curricula rather than the full range of the more than 13 curricula that were available at that time.
- Many respondents felt that the review and adoption process and selection of a standards-based mathematics curriculum was driven by the Minnesota Graduation Standards, immediately narrowing the field of candidate curricula. As one respondent recalls:

  Teachers came to the conclusion that in order to meet Minnesota Graduation Standards they could not use the traditional programs.
- Teachers felt pressured in some study districts by superintendents to complete the review and adoption process within the traditional one year time period. Given the magnitude of change needed to move from a more traditional mathematics curriculum to a standards-based curriculum, teachers felt one year did not afford them the time to fully explore options or consider the possible ramifications of a particular adoption decision. A teacher, for example, commented:

  We did everything all in one year. It would have been a much easier transition if we'd had two years, but we didn't. I think if we'd had one more year, first of all, we would have had that study year, and I think we would have done it just a little bit differently. Adopting curricula like Investigations, CMP [Connected Mathematics Program], *and Core Plus* [Contemporary Mathematics in Context], *ones where you really need time to sit down as a staff and really look at it. We didn't have that.*

Issues and concerns specific to the elementary level

Strongly generalized adoption issues specific to the elementary level did not surface during interviews with key players regarding the review and adoption process. A handful of issues, however, did emerge across the study districts.

- Cost often became a major narrowing factor, tipping an adoption decision in favor of the least expensive packages, particularly when teachers felt it was critical that the district purchase all the publisher recommended materials. One curriculum, for example, might be selected ahead of curricula with other desirable characteristics because it did not have as much consumable material and as a result is considered less costly for implementation.
- Generally teachers favored curricula in which materials were available for all the elementary grades. A good adoption decision, however, may later result in early implementation problems if the curriculum materials are not delivered on time. Teachers reported near devastating frustration when the adopted materials failed to arrive at the district on time.
- The adoption of a single standards-based curriculum across K-6 is considered desirable by teachers, but can be challenging. In the study districts, upper elementary teachers were frequently opposed to the preferred selection of the lower elementary teachers. Teachers from the lower grades often preferred a curriculum with a greater focus on mathematics fundamentals, while the upper elementary teachers preferred the more integrated mathematics curriculum. The ultimate choice in curriculum, however, often tipped toward the curriculum perceived as more "doable."

- Experienced elementary teachers do not necessarily see the need for an integrated mathematics curriculum without significant education and persuasion. When there is not "buy-in" at the review stage, teachers are equally likely to select a non-spiraling curriculum. In these situations, teachers justify their preferences in terms of needing a curriculum that is "flexible" and "easily manipulated." In some study districts, elementary teachers report their choices were limited to a small set of possible curricula (generally standards-based mathematics curricula) that were provided to them by the curriculum coordinator. As one teacher recalls:

  > *We were really never given a choice to say, 'Okay, here's a group of textbooks for you to look at.' Instead they said,. 'Here is Everyday Math and Investigations. Which one would you like to go with?'*

Issues and concerns specific to the secondary level:

- The perceived need to adopt a standards-based curriculum is not present among many high school teachers of mathematics. In only a few districts are the majority of mathematics teachers well-versed in the current literature, including familiarity and comfort with the national standards. It is not unusual, therefore, for a small number of high school teachers to definitively shape the adoption decision. As a result we see resistance and the reliance on the implementation of dual mathematics tracks. The typical pattern in this situation involves the adoption of a standards-based curriculum and the continuation of a traditional program as a choice for teachers and students across the secondary grades. A variation is the adoption of a standards-based curriculum while maintaining the traditional methods and texts in specific courses, particularly calculus and advanced mathematics. As it is difficult to maintain two streams of mathematics education in a school, having both a traditional and an integrated program may lead to more frustration and divisiveness among administrators, teachers, and parents. Even so, another rationale for the dual track is that it is a choice of least resistance while waiting for the retirement of one or more individuals who simply refuse to engage the new curriculum. Such accommodations can be easier to countenance as the curriculum is being rolled out over two or three years.

- The lack of availability of critical materials (e.g. class sets of graphing calculators) is a concern that shadows an adoption decision at the secondary level.

Implications

Our analysis of the curriculum review and adoption processes used in the study districts reveal several major findings that may be useful to other districts:

- Curriculum review and adoption processes that result in the adoption of a standards-based mathematics curriculum appear to include some common steps (e.g., creation of committees, examination of materials, visits to implementing sites, and decision making at the site level). As designed these processes may not lead to a consensus among all teachers of mathematics regarding the need to adopt this type of curriculum. Further refinement of the review and adoption process to allow more time for data-based self-study and the articulation of goals may foster a shared vision based on clearly articulated

- beliefs. Similarly committees might benefit from access to available research based knowledge about these curricula and comparative analyses of the resources needed to effectively implement each.

- In each of the study districts it appears that a central office administrator—the superintendent or a curriculum coordinator or director has been a strong advocate for the adoption of a standards-based mathematics curriculum. The role of school principals, however, is less clear and without their support, implementation may be hindered.

- Parents, school boards, and community members, at least in the study districts, did not appear to play an active role in the curriculum review and adoption process. Their lack of active participation, at this stage, does not appear to have adversely affected a decision to consider and adopt a standards-based curriculum. Given the potential for controversy, districts need to carefully consider the advantages and disadvantages to not involving these players during this critical stage.

IV. District and School Site Implementation Strategies

Once a curriculum has been adopted a district moves to the stage of implementation. During this phase district and school site plans are put into action to achieve the intended outcomes. This is the phase in which individual teachers of mathematics change as a result of new learning and follow up support (National Staff Development Council, 1995). Shifting from the use of a traditional mathematics curriculum to a standards-based curriculum requires teachers to radically change their teaching practices. Strategies to support the full implementation of these new practices must address needed changes in teacher attitudes and beliefs, knowledge, and skills. And, as the National Staff Development Council reminds us, "Change doesn't occur overnight, and recognition of the time required to institutionalize change is critical" (1995, p. 17).

In this section we describe the key elements of the implementation process used in the eight study districts to date. The section also highlights the factors influencing early implementation and common issues that emerged.

Key Elements of the Curriculum Implementation Process

As of the end of the 2000-01 school year, study school sites were from two to five years into implementation of standards-based mathematics curricula (1 district = 5 years; 1 district = 4 years; 2 districts = 3 years; 4 districts = 2 years). Districts vary dramatically, however, in the intensity and duration of support that has been provided to teachers in these sites. Half of the study districts, for example, completed their "roll out" in under two years. The longest period of support to teachers, which is still ongoing, has been seven years. The other study districts are providing at least some sustained support to teachers from three to five years.

Districts and school sites were generally most active in supporting implementation the summer prior to the school year that teachers were expected to implement the standards-based curriculum. Subsequent support may be characterized as less active. One district, however, has provided sustained support.

Example of Sustained Implementation Support

This urban district has adopted a standards-based curriculum at each level. Implementation support is multifaceted. For example, the district requires that each teacher develop a professional development plan (PDP), which sets his or her professional development objectives for the year. The district has also provided teachers with numerous opportunities to obtain initial and follow-up training through workshops and seminars that have been externally funded, usually by US Department of Education. These funds have also provided mentorship opportunities for many teachers. In addition the superintendent has made mathematics education and student achievement in mathematics a primary focus of the district.

Common Strategies to Support Implementation by Teachers

The two strategies most commonly used by study sites to promote implementation of standards-based mathematics curricula are:

- Initial training;
- Follow-up training or consultation;

Strategies used less frequently include:

- Mentoring;
- Joint planning time.

Initial training. Each of the study districts provided teachers an initial orientation and training experience the summer before the first fall of implementation. Initial teacher training at the elementary level ranged from one to five days with three days being the most common. At the secondary level, three, four or five days of initial training was common, although two districts provided two weeks of summer training for their mathematics teachers. Table 3 summarizes the responses of teachers regarding the type of support they have received. We see that 39 percent of the elementary teachers, but only 16 percent of the middle school and 17 percent of the high school teachers, considered this initial training to be less than what was necessary.

Table 3. Amount of training prior to implementation

	I thought the training was Less than was necessary		I thought the training was About right		I thought the training was More than was necessary	
	Count	%	Count	%	Count	%
Elementary	122	39%	182	58%	9	3%
Middle School/Junior High	7	16%	35	80%	2	5%
Senior High School	8	17%	36	77%	3	6%

Source: Survey of Mathematics Teachers. Spring 2001. Center for Applied Research and Educational Improvement. University of Minnesota.

While all elementary teachers from a particular school site were trained during one summer session, most study districts elected to phase in the implementation of their secondary curriculum grade-level by grade-level over a few years. Each summer training at the secondary level focused on the grade-level to be subsequently implemented in the fall. This process resulted in districts typically offering initial training at the secondary level each summer for two or three years. In some districts all mathematics teachers, including those not teaching the new curriculum that following year, have been expected to attend these summer training sessions.

Study districts were equally likely to use trainers who were representatives of the curriculum publisher or teachers from another district who had more experience in using the particular curriculum and were trained by the publishers. At the secondary level, one study district chose to send their middle and high school teachers to training sessions at a site in another state.

Initial training at the elementary level was organized so as to be grade-level specific. Training sessions varied in terms of the amount of experiential immersion in the curriculum versus planning lessons, learning about assessment, or learning to use specialized equipment such as graphing calculators. Initial training at the secondary level was organized so as to be grade band specific with middle school faculty meeting separately from high school faculty. Here too training varied as to the amount of general orientation, lesson planning, learning about assessment, and so on.

Follow up training and consultation. Study districts vary tremendously in terms of the amount of follow-up training or consultation support that has been available to implementing teachers. At the elementary level, half the study districts have not offered teachers any follow-up training. The remaining study districts have offered the following types of support to elementary teachers:

- A single one-day session for teachers during their first year of implementation;
- Five meetings over the year that varied in length from 45 minutes to two hours, focusing on working through lessons;
- Follow up, monthly sessions over the year that focused on writing lessons or trouble shooting;
- Twenty short meetings held throughout the first year of implementation where implementing teachers met with a representative from the curriculum publisher and teachers from another implementing district. The meetings focused on problem solving and sharing answers to questions that had emerged. These sessions included teachers from other districts and the publisher's representative.

The availability of follow-up training and support at the secondary level has also ranged dramatically across the study districts. Secondary teachers of mathematics in three districts were offered no follow-up training. The remaining districts in which we studied the adoption and implementation of a standards-based curriculum at the secondary level offered the following types of follow-up training and support:

- One district offered a single one-day session in the fall of the first year of implementation. The session was conducted by a trainer from the curriculum publishing company and focused on the next targeted level of high school implementation;
- Another district offered approximately 50 hours of follow-up training throughout the first year of implementation. During the second summer after initial implementation, secondary teachers were offered the option of attending an additional 40 hours of training.

Mentoring. Informal mentoring by more experienced teachers in the district has been used as a strategy to promote implementation in less than half the study districts. Selected study districts, however, did institute more formalized mentoring processes. These processes were most active during the first year or so of implementation. For example:

- In one district, secondary teachers had a mentor for each of the first two years of implementation. Elementary teachers in the same district, however, received no formal mentoring in the curriculum.

- In a second district, mentors were hired to each work with 20 to 25 elementary teachers during the first year. At the secondary level, first year teachers new to the curriculum also received mentors their first year.

- In a third district, an experienced, senior teacher was available to provide mentoring to newly hired elementary teachers.

Joint planning time. Formally scheduled joint planning time for teachers trying to implement the new curricula at both the elementary and secondary levels were infrequent. At the secondary level, two districts met once per quarter, one met twice per month, and one met weekly. At the elementary level two met weekly, one met monthly, and one met quarterly. At the elementary and secondary levels three districts had no formally scheduled joint planning time. Teachers at the elementary level, in particular, cited the need to develop the skills and knowledge to address common issues that appear to emerge during early implementation.

Factors Influencing Early Implementation

Facilitating factors. In some districts staff and school site respondents cited three factors that have facilitated the implementation process to date.

- **Administrative commitment.** Teachers commented on the importance of support from educational leaders such as school principals and superintendents. In some cases superintendents were boosters of the curriculum change. In other cases principals provided regular information about professional development opportunities in the area. Unfortunately there were some instances where principals erected barriers that directly impeded the implementation process in , for example, disallowing teachers to attend professional development seminars on the standards-based curriculum.

- **Purchasing all recommended curriculum materials.** Teachers thought it was important to have all materials recommended by the curriculum publishers. This was particularly true of elementary teachers

- **Use of additional funds and resources to support professional development activities.** Although not common, study districts have successfully sought external funds to support professional development efforts. One metropolitan district received federal funds for follow up training. None of the other seven study districts would have been eligible for this federal program funding. Four metropolitan districts, however, were assisted through National Science Foundation funding and outreach efforts centered at the University of Minnesota.

Inhibiting factors. District respondents identified two common factors that have to varying degrees inhibited implementation efforts:

- **Insufficient funds to support sustained professional development.** While respondents clearly acknowledge the need to offer a range of professional development activities to support implementing teachers, many cited a lack of funds to do so. Strategies to counter insufficient funding for initial staff development activities have included a deliberate extension of the implementation schedule in order to absorb the cost over two or more years. Other districts have been able to successfully obtain external grant funds for professional development.

- **Other faculty and staff did not receive any orientation or training regarding the standards-based curriculum being adopted.** The adoption and implementation of a standards-based mathematics curriculum involves more than the implementing teachers. Principals must be knowledgeable of the initiative in order to pro-actively address concerns of parents and to foster strategies to promote the necessary changes in teacher attitudes, knowledge, and skills. Other teachers in a building, including teachers of special education and resource teachers, must also change their practices in order to support student learning. The needs of paraprofessionals, as co-implementers under the direction of teachers, must also be anticipated and addressed. Respondents from the study districts, particularly at the elementary level, consistently mentioned that the failure to involves these other school personnel in initial training and ongoing professional development has hampered implementation.

Common Issues During Early Implementation

Several issues and concerns surfaced in the study districts during the early implementation phase. Issues that cut across implementation at both elementary and secondary levels with be discussed first followed by issues unique to each level.

General issues and concerns about the implementation. In retrospect respondents from the study districts identified five types of issues and concerns that have emerged during early implementation:

- **The importance administrative "buy-in" plays in supporting implementation efforts.** Because many principals have not been trained in the new curricula, they have not developed the necessary attitudes and knowledge base to be supportive or to evaluate teachers accurately. As a result they actually may appear unsupportive and may not fully understand the complexity of the changes required of teachers. This leads many of the teachers to conclude that administrative commitment has been lacking.

  A highly generalized concern is that on-going professional development must continue to be a high priority during the first few (three to five) years of implementation. Teachers in particular see the lack of availability of various forms of professional development as a lack of administrative commitment. Teachers at all grade levels expressed the desire for enhanced and on-going training and follow-up sessions in which they would have the opportunity to raise questions after they had acquired experience teaching the program.

- **The time and increased work load it takes implementing teachers to begin transferring new practices into their work setting was not always fully anticipated.** Planners of the implementation process generally have not anticipated and allowed adequate time for achievement of full implementation at the classroom level. Thus the concept of a phased implementation, with agreed upon expectations for changes in teacher attitudes, knowledge, and skills related to the transformation of their classroom practices at each phase, has been the exception rather than the rule. The reflections of one implementing teacher:

  > *When you implement a new curriculum, you have to give it time, no matter what. Some teachers feel they only begin to understand the nuances of teaching the new curriculum after two to three years.*

- **Strategies to support the learning process among implementing teachers have not been adequate.** In addition to citing the need for continued training, many teacher respondents commented on a need for continued opportunities to meet as a group. Formally scheduled common meeting times for teachers trying to implement the new curricula at both the elementary and secondary levels were infrequent, although the quantity of informal and ad hoc meetings and conversations on implementation was frequent across the districts. At the secondary level, two districts met once per quarter, one met twice per month, and one met weekly. At the elementary level two met weekly, one met monthly, and one met every quarter. At both levels three districts had no formally scheduled common meeting time. As one implementing teacher commented:

  > *As teachers, you need to collaborate with each other. We didn't do any staff training other than the three-day session. An hour here, or a discussion there would be helpful indeed just to keep the belief going!*

  Teachers at the elementary level, in particular cited the need to develop the skills and knowledge to address common issues that appear to emerge during early implementation: how to institute more ongoing assessments, pacing of instruction, spiraling, how students master mathematics as they move through the curriculum. These types of issues, in particular, may be best addressed through collaborative, informal, discussions among implementing teachers.

- **Implementing teachers harbor concerns regarding the adequacy of the standards-based curriculum with students who have limited English proficiency, are struggling with reading, have identified special needs, or have a history of lower academic achievement.** Our data show that little has been done to date at the district or site level to assist implementing teachers in crystallizing, examining, and potentially addressing these concerns. Typical perceptions of teachers with these concerns included:

  > *A lot of the special ed kids I have are great problem solvers but not good readers and the reading has hurt them.*
  >
  > *I think for some of the kids who are on the lower spectrum of the academic ability, and it's maybe not even their mathematic ability but their interpersonal skills and things like that, that are impacting their ability to do well in a Core program.*

  Teacher perceptions regarding the impact of the standards-based curriculum on their students is discussed more fully in Section VI.

- **Methods for assessing student achievement and mastery remain a difficult issue for most teachers.** Implementing teachers define the issue as not having the knowledge and skills necessary to score student work, a lack of standardization in assessment across teachers, and sometimes a dissatisfaction with the quality of assessment materials provided by the curriculum publisher.

  - **Implementing teachers at both the elementary and secondary levels remain concerned that the standards-based mathematics curricula do not cover particular skills or topics.** Given this belief many teachers feel the need to supplement the curriculum with more traditional skill building lessons and materials. Similarly many implementing teachers have continued to rely on more traditional teacher practices in mathematics teaching. This finding may represent the current developmental stage of implementing teachers or it could signal a weakness in the adopted curricula. The following responses of implementing teachers highlight this point:

> *Even as much, as long as I've been doing this, I still find myself, on those days when I'm tired or the kids are a little bit more unruly. I mean, you revert back right away because that works. You quiet everybody down that way and you feel more comfortable.*
>
> *I still need the students to know the basic facts. The other thing that I really stress—I go outside of the program to pull additional materials on this—is the ability to figure out how to solve problems. There's a whole logical sequence on problem solving. And so, I still use like Problem Solver. I use Continental Math to get multiple steps, to just increase their ability to think through problems. Then, once they do that, they say, 'Oh, that is easy!'*

- **Lack of parental involvement or organized communication during the stages of curriculum review and adoption and early implementation.** The adoption of a standards-based mathematics curriculum certainly raises concerns for implementing teachers, but it also affects parents who many not understand the need for this change, may not understand the shift in classroom practices, or may have concerns about the impact on their son or daughter. We saw little evidence of the involvement of parents or parent representatives during the adoption process. While respondents from the study districts did not cite extreme levels of parental discomfort at the early stage of implementation, they did acknowledge that parents have had questions and have expressed concerns about the curriculum change. Common parental concerns include:

  - Parents of high achieving children in mathematics were concerned that their children would not be sufficiently challenged;
  - Parents do not know how to help their students at home, as they are more confident with the materials of a traditional mathematics curriculum;
  - Parents cannot see the sequence and are used to a traditional math program;
  - Parents are uncomfortable with how their students will apply their knowledge and succeed;
  - Parents are also concerned with the transferability of knowledge if their children should happen to move to another district;
  - Parents are concerned because their children do not use a textbook.

  Study districts have not consistently anticipated and addressed the concerns of parents. Activities to support parents, when they have occurred, have included open houses focusing on the new curriculum, periodic newsletters, and group meetings as part of fall parent conferences. Many respondents acknowledge, however, that parents continue to need information and support in order to maintain a comfort level with the change.

Early implementation issues specific to the elementary level. Common issues at the elementary level are primarily organizational but affect implementing teachers individually.

- **Study districts have been hiring large numbers of new elementary teachers and have not anticipated the training these teachers need to change their classroom practices.** As one teacher commented:

> *We have many, many, very new teachers, so we have a lot of teachers who never even got that one or two hours because they weren't here. I estimate about half our teachers haven't even had the initial training. They received about an hour of math at a new teacher meeting. About an hour! And so they're either learning from their peers or they're fumbling around.*

- **Teachers continue to be concerned about state and district initiated student testing programs that show lower computation scores at the elementary level in some districts.** There is a question of how to maintain the strengths of the new mathematics program and still accommodate the computation issue. One result is that nearly all elementary teachers have begun supplementing the standards-based curriculum with computational skill building activities. In fact few districts have data that would indicate whether or not computations scores are likely to increase as the new programs are fully implemented.

- **Students at the upper elementary grades in many district were exposed to the new curriculum "cold turkey" in the fall of the first year of implementation after being taught for a number of years using more traditional approaches.** Teachers report that some of their students, particularly older elementary students, are struggling with the rapid implementation of the new mathematics curriculum. Teachers commented that in retrospect, it might have been smoother for students had they phased in the new curriculum by grade level, perhaps over three years.

- **One potentially damaging effect of the shift to a standards-based mathematics curriculum is the decision to group students by ability as a strategy to address their needs.** Teachers are beginning to identify potential limitations in the new curriculum, but several teachers are concerned about the use of a coping strategy that results in the separation of students based on ability. For example:

> *The goal was meeting the needs of all the different students. In fourth grade, it's a little easier because we've broken the students up. It was hard to address that issue because Everyday Math is targeted towards your so-called average students. And it was hard to hit the bottom and the top.*

- **In some study districts there is a concern over how little time some of elementary teachers in the district actually spend each day teaching mathematics.** What is not clear is the degree to which teachers in the study districts have received guidance on what is expected of them in terms of how much time they should devote to the teaching of mathematics. As one administrator commented:

> *We really want 90 minutes. But we did a survey and we found that most teachers were spending 45 minutes or 50 minutes on Math.*

Early implementation issues specific to the secondary level. Two types of issues emerged across the districts implementing standards-based mathematics curricula at the secondary level:

- **The types of curriculum materials that students would need were not always anticipated and secured.** In some instances, these materials may need to be replaced on an annual basis. For example,

> *The school invested in maybe 100 calculators for students who couldn't afford one. They were then able to borrow one for the school year.*
>
> *There were no class sets of graphing calculators purchased. So then there was a huge expenditure just in materials after the implementation was in place. So my concern is getting the graphing calculators and getting them into the hands of the ninth grade kids who can't afford them.*

- **In many study districts, implementing teachers at the secondary level are at the beginning stages of change—they have yet to acquire the attitudes and beliefs about the need for standards-based mathematics curricula that would promote the motivation for growth and learning.** There is serious concern that a common belief system is lacking. In more than one district this situation has led to the adoption of a dual track system. So while the standards-based curriculum has been implemented in the high school, some 20 percent of the students still follow the traditional curriculum. In the short term, this strategy may have served to lessen some parent and teacher concerns and potential resistance, but it has slowed full implementation. Another strategy would acknowledge that teachers will be at different stages in terms of their concerns and will therefore make available different types of assistance and support based on the stage of their concern (National Staff Development Council, 1995).

  Additionally the district-level press for students to meet the requirements of the Minnesota graduation standards has heightened the concerns of teachers of mathematics. Teachers are concerned about their students meeting the standards and coordinating the pace of instruction across teachers so that students do succeed. Some teachers are also concerned about the expectation that students who have only been exposed to the new curriculum for a few years will be able to meet the standards in the short-term (an expectation they are hearing from their school board). The lack of agreement on what is realistic to expect from students at this stage of implementation, particularly when dual tracks are used or teachers are dependent upon each other to prepare students for movement from one level to the next, is a source of tension among district players, including administrators and teachers.

Implications

This section highlights four major points, each of which has important implications for planning a successful implementation strategy.

First district training plans are typically focused on successfully launching the curriculum but may not consider the long-term follow-up professional development and support (e.g., independent learning opportunities, coaching, support groups, study groups, peer-observation and feedback, etc.) that teachers need to achieve full implementation in three to five years or even longer.

Second the importance of school principals, special education teachers, and other resource personnel to the successful implementation of a standards-based curriculum is often being overlooked. As a result these personnel are not consistently included in training and professional development activities.

Third districts and implementing teachers need support in developing the knowledge and skills necessary to address commonly identified issues: coping with possible inadequacies in the curriculum related to the needs of particular types of students (e.g., students who have limited English proficiency, poor readers, or students with special needs), the development of classroom based strategies for assessing student achievement and mastery, or guidance on how and when to address particular skills or topics not covered in the curriculum.

Fourth the adoption and implementation of a standards-based curriculum affects parents who may not understand the need for this change or how they can support their son or daughter. Implementing districts need to anticipate and develop multiple, ongoing strategies to address the needs and concerns of parents.

V. Teacher Attitudes and Instructional Practices During Early Implementation

The implementation phase following the adoption of a new curriculum involves putting plans into action to achieve the intended outcomes. This is the phase in which both individuals and the organization change as a result of new learning and follow up support (National Staff Development Council, 1995). The full implementation of a standards-based mathematics curriculum by a school district is predicated on teachers of mathematics having the necessary attitudes, skills, and knowledge to integrate the key components of the curriculum into their day-to-day teaching practice. Given the depth of change required by teachers to implement standards-based mathematics curricula, it is not unrealistic to assume that it will take five or more years for them to achieve full implementation. It must be remembered that when this study began at the beginning of the 2000-01 school year, the participating school districts and school sites were from one to four years into implementation of these curricula. The findings that follow regarding the attitudes and instructional practices of teachers implementing standards-based mathematics curricula, therefore, should be considered baseline information regarding changes in these areas.

Teacher Attitudes

A decision to adopt a standards-based mathematics curriculum and subsequent strategies to support and promote implementation appear to play a pivotal role in promoting changes in teacher attitudes and instructional practices. Several themes, common to the majority of districts, emerged from the district cross case analysis. They reflect both the current attitudes of teachers and the challenges that remain. Five of the most prominent themes include:

- Needed organizational responses;
- The magnitude of change required;
- An opportunity to gain a deeper understanding of mathematical concepts;
- A need for additional professional development to shore up content knowledge and instructional practices; and
- A need for continued teacher planning time.

Needed organizational responses. Research on the organizational change process indicates the need for leaders to establish a clear requirement to change or improve, to address both the psychological and intellectual aspects of readiness, and to articulate a clear set of intended outcomes—both for the school as an organization and for the implementing teachers (Fullan, 1991; Schein, 1999). In some districts we see administrators and teachers linking the implementation of the standards-based mathematics curricula to Minnesota's graduation standards. In a majority of the districts, however, clearly stated targets regarding expectations related to changes in teaching practices and goals in terms of student performance have not been articulated. Teachers in more than half of the districts describe a lack of consensus about the standards-based curriculum in their districts. They refer to attitudes manifested by other teaching staff and administrators, particularly school principals. For example, in about one half of the districts, there are secondary teachers who annually request that the district evaluate whether or not the standards-based curriculum is performing up to their expectations for it at the time of adoption.

Magnitude of change required. In all districts implementing teachers report that the new curriculum requires a massive shift in thinking and behaving on their part. Teachers recurrently characterized the changes resulting from the implementation as a great deal of stress, a huge leap of faith, or a paradigm shift. Teachers, for example, commented:

> *I sometimes have this really negative attitude towards math, especially because I've always struggled in it. I didn't want to pass that on to the kids. So when I present a lesson to the kids, I try not to let those insecurities show. I always tell them that when I was their age, I had a really hard time doing what they're doing, so I know exactly what they're going through. We'll struggle through this together.*
>
> *It was a big change. I had a concern that some of us would try to buck it or not accept it. Personally speaking, I was worried about bucking it a little bit. I was a good traditional math student. I could memorize my facts and so that is the way I liked to teach it. I also knew my algorithms.*
>
> *With the new structure and grading, everything I had learned in student teaching had just been thrown out the door.*
>
> *I really needed to stretch myself to be open to what kids were bringing to the table and to try and make sense of that.*
>
> *This is the first year that I really truly understand it. It has taken me three years of teaching it. We have some new teachers and when they are frustrated, I share with them the fact that it took me three years to catch on.*

In a few districts the change was so significant that district-level informants report that the teachers nearing retirement elected to retire early and may have done so to avoid major changes that the new curriculum requires to implement.

An opportunity to gain a deeper understanding. Teachers from most of the districts (seven out of eight) state that learning about, and beginning to use, the curriculum is enjoyable and that it has the potential to foster a deeper understanding of mathematical concepts. We see, then, that teachers are demonstrating a motivation for growth and an internal desire toward achieving competence in transferring the new teaching practices into their work. Teachers commented, for example:

> *I felt like the curriculum finally gave me the tools I had been testing out on my own.*
>
> *This is the eighth year that I have taught IMP One* [Interactive Mathematics Program]. *There is something new that I can learn every time that I teach the class or a lesson.*
>
> *I haven't seen one school where there have been complaints and the kids didn't learn if* [the teachers] *have really given it the shot they're supposed to and really tried. It's all been, 'Well we didn't like it from the start, but now . . .'*

A need for additional professional development. Teachers are correctly seeing the adoption of these standard-based curricula as a process, not an event. Implementing teachers consistently report they need to substantially enhance their content knowledge of mathematics to develop the competencies necessary to transform their teaching practices. Teacher respondents cite the need for additional and more advanced professional development and training.

Teachers from a majority of the districts also state that it is important for all school staff to receive some professional development on the new curriculum. Respondents specifically identified principals, teachers of special education, education aides and assistants, paraprofessionals, and substitute teachers as staff who need training.

Finally implementing teachers anticipate the need for further follow up training at regular intervals even after full implementation is achieved to ensure full and proper use of the curriculum.

Time for peer-based support. Implementing teachers from a majority of the districts cite a need for continued common planning time during the early years of implementation, not just the first year. In fact, in some districts, teachers have petitioned their principals for additional planning and preparation time with their peers. Looking at the survey data, 61 percent (n=254) agree or strongly agree that finding enough planning time is a problem with the standards-based curricula, and only 20 percent (n=90) disagree.[1]

> *I really think that this curriculum, and the way we did it, probably created a sort of a survival mentality in our department. And when you do that you don't want to go alone.*

Instructional Practices

Implementing teachers, on average, report they are making significant changes in their teaching practices. At the same time, many teachers report they are continuing to supplement their instruction heavily with another, more traditional curriculum. Data from a small number of classroom observations across the districts indicate that most implementing teachers are at the early stages of changing their instructional practices.

Findings related to instructional practices group in two areas:

- Changes in teaching styles and practices;
- Challenges that must be faced in order for new practices to be implemented.

Changes in teaching styles and practices. Implementing teachers commonly report three areas of change in terms of their style of teaching: (1) an increased frequency and improved quality of teacher questioning and listening, (2) a role shift from predominantly lecturing to facilitating student discovery, and (3) changes in the physical arrangement of the classroom, for example grouping desks rather than rows or using tables rather than individuals desks.

From the classroom observation data, we see that while teachers are beginning to make changes in their teaching styles, they are generally in the early stages of implementation. In this early stage teachers focus on adapting portions of the new curriculum into their existing practices or continue to supplement the standards-based curriculum with more traditional practices. From the survey data we find that, on the traditional side, 71 percent of the teachers (n=312) are using lecture and formal presentation almost every day or often.[2] On the other hand, 86 percent (n=427) encourage their students to explain their reasoning when giving an answer almost every day or often, and 91 percent encourage their students to explore alternative strategies for solving problems.[3] Key trends from the observational data include:

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[1] See Appendix C, Survey of Mathematics Teachers, Spring 2001. Center for Applied Research and Educational Improvement. University of Minnesota. Question 26g.

[2] See Appendix C, Survey of Mathematics Teachers, Spring 2001. Center for Applied Research and Educational Improvement. University of Minnesota. Question 15b.

- During a 55 minute classroom observation, implementing teachers were observed using a mixture of both reform and traditional teaching methods. For example in the majority of classrooms, students no longer sit in desks arranged in rows and teachers spent relatively little time just lecturing. A calculation of all time in minutes spent in instruction indicates that 55 percent of the time teachers continue to use traditional teaching methods including lecture, lecture with response, teacher led problem solving, and teachers solving problems. Forty-five percent of the time is spent in more reform teaching, including students in small groups solving problem and students sharing their solution strategies.[4]

- Students participated in a mixture of activities. Overall students spent the largest amount of time working independently—on average about fifteen minutes of every hour. Independent work falls more on the traditional side of the reform methods continuum.

Challenges. Implementing teachers report two common challenges they must face during early implementation: (1) the need for dramatically increased planning time, and (2) the increased complexity of assessing students and teaching objectives when the new curriculum was used. For example, teachers commented:

> *When you are teaching a new curriculum, you are one day to one week ahead of the kids. Throw on top of that the fact that you're teaching three to four preps, and you realize how much time the teachers are putting in.*
>
> *Assessment takes a terrific amount of time; then to tell the parents how you assessed is also much more time consuming.*

The potential benefit of affording implementation teachers continued opportunities for coaching, support groups, and study groups is highlighted by the coping strategies that teachers disclosed:

- One teacher reported developing a daily assessment tool for students that she carried through the classroom on a clipboard;

- Many elementary-level teachers described sending games home with children to play with their families.

Implications

Findings about the attitudes of implementing teachers and the current status of their instructional practices should be looked at as baseline findings. Given that a majority of the study districts are at the very early stages of implementation, we are encouraged by these findings. At the same time, the findings are a clear signal that continued professional development and support is needed by teachers to successfully transform their classroom practices.

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[3] See Appendix C, Survey of Mathematics Teachers. Spring 2001. Center for Applied Research and Educational Improvement. University of Minnesota. Questions 15d and e.

[4] These findings, however, are skewed by two teachers who had students working in small groups for the majority of the class period—43 minutes in one case and 42 minutes in the other.

Two additional types of organizational responses by districts may be warranted:

- District training plans should include the articulation and communication of objectives related to the attitude change, skill development, and knowledge acquisition needed by teachers to successfully transfer the new practices to their classroom settings.

- District leadership should work with implementing teachers to establish clear expectations and measurable outcomes regarding needed changes in classroom practices. Teachers may benefit from having a realistic set of performance benchmarks related to their classroom practice during the first, second, third, and successive years of implementation of a standards-based curriculum. Professional development strategies must be sensitive to the needs of teachers over time. It must be anticipated that teachers will have different needs during each phase of implementation and that teachers within the same school site may be at different phases at any point in time (particularly new hires that arrive after the first year of implementation).

VI. Teacher Perceptions of Changes in Student Attitudes and Behaviors

The shift to a standards-based mathematics curriculum is intended to promote changes in student attitudes, behaviors, knowledge, and ultimately their performance. Though clearly not the focus of this study, recurring themes did emerge relating to students' attitudes and behaviors. Caution must be exercised when drawing conclusions from the information presented in this section, as it reflects the self-reported perceptions and opinions of teachers and not of the students themselves. The findings should be considered exploratory and in need of verification through more systematic data collection involving students.

The section briefly summarizes the impressions of implementing teachers regarding student experiences during early implementation, perceived challenges for students, and early evidence of changes in student attitudes and behaviors.

Variation in Student Experiences

The experiences of students during early implementation of a standards-based curriculum range widely. Below we provide examples of variations in two sets of vignettes. The first set characterizes the student experience across grades at the time of implementation. The second set attempts to show how the schools' approaches to implementation affect students' perceptions.

Some of the more stark contrasts are related to the timing of the implementation with respect to individual students. For example, consider the cases of hypothetical elementary students A and B.

> **Student A** *is in the first grade. Last year she was in an all-day kindergarten at the same school and began to learn mathematical concepts in a practical way. In first grade, the first year of standards-based curriculum implementation, she learns several different approaches to solving mathematics problems in teams with other children. At the outset of her experience with mathematics there are many games and practical applications to learn mathematics concepts. The subsequent years build on this experience.*
>
> **Student B** *is a fifth grader. During the five previous years, teachers taught this student one way of solving mathematics problems using algorithms. The student occasionally worked in groups but more often solved worksheet problems independently. Now in fifth grade, student B is presented with many ways to solve problems. Where before the student worked independently, the student now is encouraged to work in groups. Additionally the teacher does not press the student to master a specific procedure or concept; rather, the teacher says they will come back to the problem later.*
>
> This latter case, while overly simplistic, characterizes some of the challenges teachers reported that students actually have encountered. Specifically teachers stated that students in the higher elementary grades were having the most difficult time adjusting to the new standards-based curricula.

High schools also varied in their approach to the curriculum, and, as a result, students experiences varied significantly.

Two examples highlight the variation in student experiences at the secondary level.

High School A

High School A's implementation of the standards-based curriculum was largely mandated from district administrators in an attempt to raise student test scores and align the curriculum with the Minnesota state graduation standards. Taken as a whole, teachers in high school feel that the previous, more traditional, curriculum "does the job." Teachers have resisted the adoption to the extent that, initially, only the newest teacher in the school was trained in the new curriculum. The standards-based curriculum, for example, replaced the business mathematics course, intended for non-college-bound students, who comprise the lowest third of student body. The traditional mathematics strand, as well, provided a more advanced level of mathematics for high achieving students. Expanding the standards-based curriculum to more students and courses has been met with resistance from veteran teachers, parents of higher achieving students, and the students themselves, all of whom perceive the curriculum as a remedial course.

This vignette can be contrasted with High School B, which followed a markedly different approach to the curriculum implementation.

High School B

High School B's implementation of the standards-based curriculum was largely teacher driven. Seasoned teachers had two goals: meet the needs of more students and provide opportunities for students to have a more profound experience in mathematics. While the district administrators had specific goals for its mathematics program, they decided to allow teachers to choose between traditional or standards-based curricula. As a group a few teachers in high school B decided to use the standards-based curriculum for the international baccalaureate (IB) courses. These courses are generally attended by high achieving, college-bound student. The standards-based courses were quickly accepted by parents of high achievers, and students from all levels wanted to take courses that were offered in the prestigious IB program.

Challenges for Students

Implementing teachers on average were much more likely to report that the standards-based curriculum meets the needs of the "average" or "high achieving" student than students with special needs or those with limited English proficiency (refer to Table 3).

Table 4. Teacher perceptions of how the standards-based curriculum meets the needs of students

	Strongly Agree		2		Neither Agree Nor Disagree		4		Strongly Disagree		N/A / Don't know	
	n	%	n	%	n	%	n	%	n	%	n	%
Our curriculum meets the needs of average math students	103	25%	213	51%	61	15%	33	8%	9	2%	103	25%
Our curriculum meets the needs of high achieving students	103	25%	188	45%	56	13%	50	12%	24	6%	103	25%
Our curriculum meets the needs of students with special needs	24	6%	79	19%	89	21%	128	30%	102	24%	24	6%
Our curriculum meets the needs of students with limited English proficiency	10	2%	63	15%	138	34%	111	27%	88	22%	10	2%

Source: Survey of Mathematics Teachers. Spring 2001. Center for Applied Research and Educational Improvement. University of Minnesota.

Using a five-point scale, teachers rated the degree to which they strongly agreed or agreed (rated as a 1 or 2, respectively) with the following statements about their students:

- Our curriculum meets the needs of average math students (76 percent rated item a 1 or 2);
- Our curriculum meets the needs of high achieving students (70 percent rated item a 1 or 2);
- Our curriculum meets the needs of students with special needs (25 percent rated item a 1 or 2);
- Our curriculum meets the needs of students with limited English proficiency (17 percent rated item a 1 or 2). (It is important to note that while students with limited English proficiency tended to have more difficulty using the standards-based, language-centered curriculum, teachers in three districts viewed it as a means of reinforcing language skills.)

Implementing teachers also offered interview comments regarding how they see the standards-based curriculum affecting their students. These comments tended to be more classroom or school specific with little cross-site patterns emerging. Taken as a whole, no specific issue or concern was raised in more than four of the eight districts. The comments grouped into the following areas:

- Students are being asked to take more responsibility for their own learning. This has been a potent change for the students more accustomed to teacher-led learning and problem solving, particularly common in mathematics. One teacher comments:

I think it's particularly tricky because you're actually asking students to take a lot more responsibility for what they learn. And some of them are real anxious.

- Some students are finding it harder to stay on task. For example, the transition from individual work to group work has been difficult for many elementary school students. Students are quite used to having more or less constant teacher direction and control. Now, however, the shift is to a student centered pedagogy rather than teacher centered and group centered rather than self-centered.

- In the transition some students are finding it challenging to shift from the abstract concepts of mathematics to the more real-life applications posed in the standards-based mathematics curriculum. This change reaches students at many levels. For example, a shift from symbolic manipulation and algorithms to multiple-strategy approaches has repositioned some students within the classroom. Teachers report that some more verbal students find the standards-based curriculum provides an inroad into mathematics. Two illustrative quotes, the first from a teacher, the second from a parent provide additional insight into the student experience.

  Another piece is being able to change the mindset with what kids need to know. You can give kids the skill to do a problem, but it was hard for them to realize that they had to be bumped up to a real life application level.

  The benefits to my children have been that it is more practical math. Sarah being not a reader, that is my high schooler, always struggled with word problems, and one of the things that integrated math asked her to do was it gave her numbers and asked her to make a word problem. And all of a sudden the whole word problem clicked for Sarah, because it was like the curriculum asked her to do it backwards, which, for her, was great! It finally taught her what words go into making a problem. So all of a sudden, in middle school, it was really fun seeing this light bulb go on. Late or not, this light bulb went on for her, and all of a sudden, word problems were not quite so hard anymore. That was exciting.

- Teachers report that some students are rebelling against the changes by disrupting group work or resisting the search for multiple solution strategies. This issue was raised in relatively few instances across the eight districts.

Early Evidence of Changes in Attitudes and Behaviors

Implementing teachers also noted many areas in which they are seeing changes in student attitudes and behaviors related to mathematics. Teachers from across most of the study districts report:

- Students are more engaged in higher level thinking skills and developed a deeper understanding of mathematical concepts as a result of using a standards-based mathematics curriculum;

- More students are experiencing success with mathematics. For example, a teacher comments:

> *I think just seeing the success rate that kids have. I know I've had fewer students fail than ever. All of a sudden they understand.*

Implementing teachers from selected study districts report:

- Students who are exposed to a standards-based mathematics curriculum are covering a given amount of material in a shorter period of time. In some cases, students were reported by teachers to be covering four years of traditional mathematics curriculum in three years.

- Students appear to prefer courses or class periods in which a standards-based mathematics is taught. Frequently teachers described students who wondered where the time went and elementary teachers said that students regularly indicated that they preferred mathematics time to other subjects.

- Students are more likely to sign up for mathematics courses when a standards-based mathematics curriculum is offered. Both elementary and secondary teachers related that some students simply 'liked math better,' and in other cases the subject was demystified and student confidence grew. Illustrative teacher comments:

> *The most impressive thing to me is the fact that I have kids that thought they were bad at math that now think they are good at math. That is the most significant improvement that we have had.*
>
> *When we first started teaching a standards-based curriculum, 65 percent of our seniors were taking a math class. Right now we're up to 90 percent.*
>
> *The interaction of the kids and their partners and the feedback they have given me suggests they are really enjoying the program. It is relevant to them, and it's not just mundane bookwork for them.*

Implications

Anecdotal findings regarding student experiences during early implementation highlight the fact that moving from more traditional mathematics instruction to standards-based instruction may affect students differentially. For some students, the change is welcomed after some initial adjustment; for others, the change may be stress producing. Districts need to anticipate this range of responses and offer guidance and support to students and their parents during this transition.

Teachers' impressions regarding the early impact of these curricula on their students point at a number of outcome areas that might be assessed during the second phase of this study:

- On-task classroom behavior;
- Self-confidence and attitudes toward mathematics;
- Course taking patterns;
- Knowledge acquisition rates;
- Performance on activities requiring higher order thinking skills and reasoning;
- Understanding of mathematical concepts.

VII: Conclusions

A very quick reading of the preceding sections may suggest a too simple—an incorrect—conclusion: that the adoption and early implementation of standards-based mathematics curricula have been less than expected in the study districts. The opposite is true.

The study districts and sites represent examples of successful standards-based mathematics curriculum adoptions. As would be expected, teachers of mathematics in these school sites are at the beginning stages of implementation and continue to need support to transform their teaching practice. District administrators across the study sites, however, are to varying degrees providing the necessary time, resources, and support structures to facilitate the necessary deep changes in teacher attitudes, knowledge, and behaviors.

Key findings that emerged from our analyses of the experiences of these eight study districts may be summarized as:

- Curriculum review and adoption processes that result in the adoption of a standards-based mathematics curriculum appear to include some common steps (e.g., creation of committees, examination of materials, visits to implementing sites, and decision making at the site level). As designed these processes, particularly at the high school level, may not lead to a consensus among all teachers of mathematics regarding the need to adopt this type of curriculum.

- In each of the study districts, there appears that a central office administrator—the superintendent or a curriculum coordinator or director has been a strong advocate for the adoption of a standards-based mathematics curriculum. The role of school principals, however, is less clear and without their support implementation may be hindered.

- Parents, school boards, and community members, at least in the study districts, did not appear to play an active role in the curriculum review and adoption process. Their lack of active participation, at this stage, does not appear to have adversely affected a decision to consider and adopt a standards-based curriculum.

- District training plans are typically focused on successfully launching the curriculum but may not consider the long-term follow-up professional development and support (e.g., independent learning opportunities, coaching, support groups, study groups, peer-observation and feedback, etc.) that teachers need to achieve full implementation in three to five years or even longer.

- The importance of school principals, special education teachers, and other resource personnel to the successful implementation of a standards-based curriculum is often being overlooked. As a result these personnel are not consistently included in training and professional development activities.

- Implementing teachers report some common issues for which they need assistance and support: coping with possible inadequacies in the curriculum related to the needs of particular types of students (e.g., students who have limited English proficiency, poor readers, or students with special needs), the development of classroom-based strategies for assessing student achievement and mastery, or guidance on how and when to address particular skills or topics not covered in the curriculum.

- Teachers report that the adoption and implementation of a standards-based curriculum affects parents who may not understand the need for this change or how they can support their son or daughter. In selected study sites we see attention to the needs of parents, including the use of open houses focusing on the new curriculum, periodic newsletters, and group meetings as part of fall parental conferences. Many teacher respondents, point out, however, that parents continue to need information and support in order to maintain a "comfort level" with the change.

- In all of the study districts, implementing teachers report that the new curriculum requires a massive shift in thinking and behaving on their part. While they report they are making significant changes in their teaching practices, many teachers report they are continuing to supplement their instruction heavily with another, more traditional mathematics curriculum. Data from a small number of classroom observations across the districts, indicate that on average, implementing teachers are at the early stages of changing their instructional practices. Findings about the attitudes of implementing teachers and the current status of their instructional practices should be looked at as baseline findings. Given that a majority of the study districts are at the very early stages of implementation, we are encouraged by these findings. At the same time, the findings are a clear signal that continued professional development and support is needed by teachers to successfully transform their classroom practices.

- Anecdotal findings regarding student experiences during early implementation highlight the fact that moving from more traditional mathematics instruction to standards-based instruction may affect students differentially. For some students the change is welcomed after some initial adjustment; for others, the change may be stress producing.

- Teachers' impressions regarding the early impact of these curricula on their students point at a number of outcome areas that might be assessed during the second phase of this study:

    - On-task classroom behavior;
    - Self-confidence and attitudes toward mathematics;
    - Course taking patterns;
    - Knowledge acquisition rates;
    - Performance on activities requiring higher order thinking skills and reasoning;
    - Understanding of mathematical concepts.

What are the implications of this for district leaders and SciMath^{MN}? The most obvious implication has already been stated—the implementation process is just that, a process, not an event. The deep changes required by implementing teachers requires sustained opportunities for independent and interdependent learning. Another key implication related to the quest for data on the impact of standards-based curricula on student achievement is that until we can establish that a standards-based curriculum is being even moderately implemented in a sample of Minnesota districts and school sites, it is premature to launch an impact study.

The CAREI study team, therefore, recommends that phase two of this study, focused on an assessment of student outcomes, be deferred until the implementation of standards-based mathematics curricula by teachers reaches a targeted level. Work in the coming year might focus on a number of areas related to implementation and an evaluation of changes in student performance:

- Additional in-depth study of classroom practices of implementing teachers in a sample of districts during 2001-02 in anticipation of partnering with districts in which at least moderate implementation has been established schoolwide.

- The refinement of a set of instruments (e.g., a teacher questionnaire, district checklist to assess strategies being used to support implementation by teachers, an observation protocol to assess changes in classroom practices) to track the implementation status of a standards-based curriculum that could be used by SciMath^{MN} in their work with other Minnesota districts.

- The specification of a core set of student outcomes and the theoretical basis for each, including the identification and review of instruments and other sources of data (e.g., Minnesota's statewide mathematics assessments and standardized student assessments commonly being used in Minnesota districts) to determine their adequacy as measures of these outcomes.

Appendix A: Study Method

Guiding Study Questions

1. What does the national literature say about the conditions for successful implementation of standards-based math curricula and teacher change?

2. What strategies and criteria did the eight Minnesota case study districts use during their adoption processes?

3. What district and building-level implementation strategies have been employed in the eight case study districts?

4. How did adoption and implementation strategies affect teacher attitudes and practices, if at all?

5. What are baseline teacher attitudes, beliefs, and instructional practices in the 16 case study buildings and perhaps more broadly in the eight case study districts.

Characteristics of Study Districts and School Sites

During the summer of 2000, the study team, in cooperation with SciMath Minnesota, identified schools with strong implementation as candidate districts and school sites that met the following criteria:

- A majority of those teaching the standards-based curricula received initial training before beginning to use the curriculum in the classroom;
- Teachers in the building are using the standards-based curriculum consistently (e.g., not substituting units from traditional texts);
- Curriculum-specified resources are available in classrooms (e.g., calculators, manipulatives and supplies);
- Ongoing professional development and support is available to and being used by a critical mass of teachers implementing the curriculum (e.g., demonstration lessons from mentors, team teaching, joint planning, peer observation);
- Principal and department chair has had training to identify and support standards-based mathematics instruction in the classroom including inquiry-based learning, students working in groups, student explanations of strategies, and so on;
- Teachers teaching and students learning mathematics is a priority for building-level resource allocations.

Other important considerations included:

- Building principal and mathematics faculty were willing to cooperate with data collection effort;
- There was at least one building-level respondent with enough tenure to talk about planning for initial and early implementation whenever that happened;
- At least 50 percent of the mathematics faculty have been at the school for the last two or three years

Optimally:

- If implementation was phased in throughout the district, buildings entering their second year of implementation in 2000-2001 were preferred. Similarly, avoid buildings beginning implementation in fall 2001;
- The current principal had been in the building's leadership for the entire period of implementation, which usually meant at least 2 years.

Selected districts represent a diverse set of Minnesota school districts. For example, student enrollment in these districts ranges from just over 500 to almost 50,000. The characteristics of enrolled students, based on ethnicity, race, and socio-economic status, also varies widely across the eight districts. Characteristics of the study districts are summarized in Table 5.

Table 5. Characteristics of study districts as of fall 2000

	District							
General K-12 Information	**1**	**2**	**3**	**4**	**5^**	**6**	**7**	**8**
Limited English Proficiency (LEP)	0%	5%	0%	1%	2%	22%	2%	0%
Special Education	11%	10%	9%	11%	9%	13%	10%	13%
Free or Reduced Lunch	28%	10%	9%	23%	38%	66%	16%	35%
Mobility Index (Intra and Inter)	17%	21%	7%	8%	12%	33%	18%	8%
Drop Out Rate	5%	1%	6%	2%	1%	10%	1%	0%
PK-12 Operating Expenditure Per Pupil	$7,379	$8,491	$6,016	$6,228	$6,873	$10,226	$6,503	$6,855
Total Operating Expenditure Per Pupil	$8,351	$9,404	$6,545	$7,283	$8,186	$11,290	$7,329	$7,297
Total Students Enrolled Grade 8 (Oct. 1.)	351	681	152	189	130	3,354	872	32
Total Students Enrolled Grade 9-12 (Oct. 1.)	1,695	2,854	649	726	478	13,553	3,639	208
Total Students Enrolled Grade K-12 (Oct. 1.)	4,338	8,326	1,681	2,046	1,354	48,397	11,412	517
Gender/Ethnicity								
Male	2,234	4,423	845	1,091	667	25,184	5,927	273
Female	2,149	3,981	854	971	702	23,650	5,627	251
American Indian	237	71	2	2	3	2,184	114	6
Asian Pacific Islander	37	342	15	15	8	7,161	623	5
Hispanic	32	323	4	82	89	4,471	303	11
Black	21	548	25	15	8	21,725	556	2
White	4,056	7,120	1,653	1,948	1,261	13,293	9,958	500
Total	4,383	8,404	1,699	2,062	1,369	48,834	11,554	524

Table 5 *continued on next page*

Continued: **Table 5. Characteristics of study districts as of fall 2000**

	District							
Grade 8 Test Score Information	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Reading								
Percent of Grade 8 Students At or Above Scale Score 600	79%	89%	85%	82%	75%	51%	78%	79%
Average Score for All Students Tested	34 *	35 *	34 *	34 *	33 *	28 *	33 *	35 *
Average Score for All Students Enrolled as of Jan. 1 of Prior Year	34 *	36 *	34 *	34 *	33 *	28 *	33 *	35 *
Average Score Not Including LEP Students	34 *	36 *	34 *	34 *	33 *	29 *	33 *	35 *
Percent of Grade 9-12 Students At or Above Scale Score 600	48%	52%	52%	41%	27%	26%	41%	70%
Mathematics								
Percent of Grade 8 Students At or Above Scale Score 600	69%	82%	79%	77%	67%	42%	69%	64%
Average Score for All Students Tested	54 **	57 **	56 **	56 **	54 **	46 **	54 **	56 **
Average Score for All Students Enrolled as of Jan. 1 of Prior Year	55 **	58 **	56 **	56 **	54 **	46 **	54 **	57 **
Average Score Not Including LEP Students	54 **	58 **	56 **	56 **	54 **	46 **	54 **	56 **
Percent of Grade 9-12 Students At or Above Scale Score 600	36%	36%	45%	39%	34%	22%	24%	43%

Source: Minnesota Department of Children, Families & Learning, 2001. Data Center.

Note. * These average reading scores are on a scale of 1 through 40.

** These average mathematics scores are on a scale of 1 through 68.

The curricula adopted in each of the study districts and the year(s) of implementation are shown in Table 6.

Table 6. Curriculum adopted and implementation year(s)

District		Elementary[1]	Middle School[2]	High School[3]
1	Curriculum	Everyday Math	STEM	Core Plus
	Year Implemented	2001[4]	2000	1998-2000
2	Curriculum	Investigations	CMP	Core Plus
	Year Implemented	1998	1998-1999	1998-2000
3	Curriculum	Investigations	CMP	Core Plus
	Year Implemented	1998	1997	1997-1999
4	Curriculum	Everyday Math	CMP	Core Plus
	Year Implemented	1998	1998	1998-2000
5	Curriculum	Investigations	CMP	Core Plus
	Year Implemented	1999	1999	[prior to 1999]
6	Curriculum	Everyday Math	CMP	IMP
	Year Implemented	1997	1997	1997
7	Curriculum	Everyday Math	STEM	Arise
	Year Implemented	1998-1999	1998	1998
8	Curriculum	Investigations	CMP	Core Plus
	Year Implemented	1998	1998	1998-2000

[1] Elementary School
    Everyday Mathematics (EM or UCSMP or Chicago Math)
    Investigations in Data, Number, and Space (Investigations)
[2] Middle School
    Connected Mathematics (CMP)
    MATH Thematics (STEM)
[3] High School
    Contemporary Mathematics in Context (Core Plus or CPMP)
    Interactive Mathematics Program (IMP)
    Mathematics: Modeling Our World (ARISE)
[4] Adoption occurred after the period of the study.

Review of Relevant Literature

The research team conducted a review of some 50 research studies, papers and articles to gain an understanding of curriculum adoptions and implementations of standards-based mathematics in the following content areas:

- Curriculum reform
- Standards-based mathematics curriculum reform
- Professional development of teachers
- Assessment of state graduation standards
- Student achievement in mathematics
- Shifting from policy to practices

The aim of this search was to systematically summarize the defining characteristics, processes and factors related to district curriculum adoptions and implementation and their affect on teacher attitudes and instructional practice.

Seven key findings emerged from the review of literature:

- Deep change of teachers and students;
- Professional development strategies vary widely and have an affect on teacher practice;
- Policymakers continue to assume that teacher behavior can be changed with curricular overview sessions and single shot workshops;
- There is an important relationship between teacher knowledge and student performance;
- The effects of standards-based mathematics curricula on student achievement as yet remains unclear;
- Critical elements of successful implementation;
- Self-reports may be a weak measurement instrument with regard to capturing reform in classroom instruction.

Study Instrumentation

The study team developed three instruments to assist in the gathering of information to address the guiding questions 2, 3, 4, and 5.

In-depth interview protocol. The interview protocol covered the following topics:

- Time worked in the district and district responsibilities;
- Involvement in the decision to adopt the standards-based curriculum;
- District efforts to improve mathematics education over the last three to five years;
- Characterization of mathematics education in the priorities of the district;
- Description of the process used when the district decided to adopt the standards-based curriculum;
- Description of the strengths and weaknesses of the process;
- Amount of initial and follow-up training teachers received;
- The ongoing professional development support offered to teachers by the district;
- Other organizations that provided professional development or other support;
- Building-initiated efforts to support implementation;
- Greatest challenges and benefits associated with implementing the curriculum;
- Individuals who have moved the implementation process forward;
- Most significant changes for teachers regarding instruction and assessment;
- Parent response;
- Changes in student attitudes and behavior since implementation.

Site visits to interview key staff from each study school district occurred in the fall of 2000. Typically respondents included superintendents from the smaller districts, the curriculum coordinator for the district, and four implementing teachers—two elementary and two secondary. Whenever possible teachers selected for interviews were considered by the curriculum coordinator to be strong implementers of the standards-based mathematics curriculum being implemented in their school.

Teacher survey. The study team also created a teacher survey to gather information from teachers of mathematics more broadly. The study team initially collected other instruments that attempted to gather information about curriculum reform, especially mathematics reform questionnaires. Key questions were identified and placed as potential candidates for the teacher survey. From these questions a draft prototype of the survey was created and sent to experts in the fields of mathematics reform, mathematics education, educational reform, teacher education, and state education staff for comments and suggestions. Using comments received a final draft of the survey was developed and piloted by both elementary and secondary teachers taking graduate education classes in a metropolitan university and teacher candidates from an area university. Topics covered in the teacher survey include:

- Personal background
- Current teaching and classroom activities
  - Student activities and frequencies
  - Teacher instructional activities and frequencies
  - Teacher views and opinions about themselves, their students, and mathematics education
- Experience using standards-based mathematics curricula
- Views on their particular curriculum adoption process
- Training and professional development
- Views and opinions on the curriculum
- Three open-ended questions:
  - Greatest change in teaching as a result of the new curriculum
  - Greatest challenge since implementing curriculum
  - Greatest benefit to the students as a result of using the curriculum.

The teacher survey was administered in early spring of 2001 at each of the eight study districts to teachers of mathematics. All teachers of mathematics in the five smaller districts (enrolling fewer than 8,000 students) and a sample of teachers in the three largest study districts were surveyed. In all 475 written surveys were administered to teachers of mathematics in 32 schools. The total number of teacher surveys returned was 437, for a 92 percent return rate.

Classroom Observation Protocol. The study team also developed a protocol to conduct classroom observations in each of the sixteen schools in the eight districts. During each observation session, a trained observer completed the following activities.

- At each classroom transition, observers recorded the time in minutes, the teacher activities, and rated both the students level of engagement and cognitive demand placed on the student.

- Elements of the Observation Scale designed for the Mathematics in Context Longitudinal Study (Davis, Wagner & Shafer, 1997) was used at the end of each classroom observation to provide a general summary of the level of reform teaching taking place in each classroom.

The observation protocol was pretested on five occasions, three times, using taped classroom sessions and two times in actual classroom settings. The pretesting was conducted to help assure interrater reliability between the three trained observers.

In all, thirty, one-hour classroom observations were conducted in April and May 2001.

We used six major steps to reduce and analyze the data that were collected from in-depth interview respondents:

1. Interviews were audio taped and fully transcribed.
2. Individual transcriptions were combined by question to provide a complete transcription of the district.
3. The compiled transcription was analyzed for recurrent themes and placed in a district profile template.
4. A narrative district profile was produced from the district template.
5. Profiles were submitted to their respective districts for verification and the opportunity to add a postscript to the profile.

For the teacher survey, data were punched and verified by a commercial keypunch firm in the metropolitan area. Frequencies and crosstabulations were run with SPSS statistical software.

The observation instrument data was entered into an Excel spreadsheet directly and analyzed for trends in percent of time on traditional instructional practices and percent of time on instructional practices generally considered reform oriented.

Limitations of the Data

The reader needs to be aware of the key limitations of the data we collected

- Individual interviews
    - Teachers' and administrators' perceptions of parents and students are their perceptions.
- Teacher survey
    - While the overall 92 percent return rate was excellent, the sample of teachers in the three largest districts—all in the metropolitan area—are best characterized as representative samples among the high schools and elementary schools of the respective districts and not random or systematic samples. All teachers of mathematics in the five smaller districts were surveyed.
- Classroom observation
    - In the spring of 2001, each of the 30 observations was conducted for one hour. Perhaps these would be better characterized as "snapshots" than "observations."

APPENDIX B: District Profiles Of Adoption And Early Implementation

DATA SOURCES FOR ALL SITES

Data sources for the case studies come from individual interviews conducted in fall 2000. From seven to 12 key district contacts were identified and interviewed for 45 to 60 minutes. Additional data sources include:

- A teacher survey of all teachers in the district teaching mathematics, administered in early spring 2001;
- A one hour classroom observation of teacher instructional practice and student activities; and,
- District and school data collected from the Department of Children, Families and Learning Data Center.

DISTRICT 1 PROFILE

BACKGROUND AND SETTING

District and site characteristics – The district is an isolated rural community that has been interested in the quality improvement process. Strong leadership is in place, and the recent adoption of statewide graduation standards and basic skills tests has put mathematics education in the district spotlight. The community is home to an important non-profit organization that is a major community supporter and takes special interests in education and the schools. The organization agreed to provide support, including staff training, if the district opted for NSF based math curricula. Prior to the NSF curriculum adoption, there was no set mathematics curriculum.

District 1	
Location	Rural
Enrollment	4,338
Percent eligible for free or reduced lunch	28%
Percent with limited English proficiency	0
Student mobility	17%
Percent enrolled in special education	11%
Percent passing Grade 8 Basic Skills Test	Reading 79% Math 69%

Source: Minnesota Department of Children, Families & Learning, 2001. Data Center.

THE CURRICULUM ADOPTION PROCESS

The decision to adopt new mathematics curricula was initiated by the high school teachers who felt that students needed problem solving skills for application of their math knowledge. Teachers also believed that the push for more students to have four years of mathematics (rather than three year) would be much more attainable with a standards-based, integrated math curriculum. Once the administration bought into the high school adoption, the superintendent was instrumental in encouraging the middle school staff to select a curriculum that would both meet their needs and align and support the high school effort. The district is currently working with the elementary school for their upcoming adoption.

Major Elements of the Adoption Process - The adoption process for high school was three years. The adoption began with ninth grade as it was being added to the high school. The next year tenth grade was brought on board, and finally in the third year eleventh grade was added. The middle school took two years for implementation and began two years after the high school. Seventh and eighth grades were introduced followed the next year by sixth grade. The elementary school is reviewing curricula and hopes to begin implementation shortly. Elementary schools have not yet adopted a curriculum. The adoption process included four major elements, with some variation across the middle school and secondary sites.

1. Creation of a new math committee at each grade level. Curriculum committees were composed of teachers only.

   Variation - The high school math committee was afforded the greatest autonomy, as they were the leaders of the adoption of new curricula. The middle school was slightly less autonomous as their program selection had to support the high school. Both were encouraged to accept NSF curricula as this is what the outside funding agency preferred.

2. Teachers approached various textbook representatives by telephone, to peruse the curriculum options available.

3. Teachers from other districts already using the curricula were invited to the school. In addition, a number of teachers visited school sites that were implementing various mathematics curricula.

   Variation: The visits varied in terms of which teachers participated, which grade level, and which curriculum was observed.

4. Teachers made the final selection of mathematics curricula.

   Variation: The high school teachers unanimously agreed to adopt a particular curriculum. The middle school felt somewhat pressured to adopt a curriculum that would support the high school. They did not want to feel pressured by the high school or administration. After some consideration they unanimously chose a curriculum.

Key players - One high school teacher was instrumental in initiating enthusiasm for standards-based mathematics curricula among the other math teachers. The high school and middle school teachers, along with the superintendent, had the greatest influence during the adoption process. The district school board and principals were supportive but did not actively drive the process. Their role was to represent the community voice, delegate responsibility for the adoption process to the teachers, and provide logistical assistance. The superintendent, in particular, wanted to see reform that would result in improved student test scores on achievement tests. The parents were not approached for input.

Three types of players who also had some influence on the adoption process included the community non-profit organization that supplied financial support, salespeople from the curriculum publishers who furnished the curricula, and teachers from other districts who shared their experiences of teaching the new curricula.

KEY ISSUES DURING THE ADOPTION PHASE

There were a number of issues that arose at the middle school and secondary school.

At the middle school site
Issue - While the middle school teachers felt that they would like to adopt an integrated math program and agreed that they needed to support the high school, they did not want to feel pressured by the high school staff and administration into making a decision.

Issue - There was a concern that the program was difficult for students and lacked coverage on certain subjects. The teachers supplemented topics if they felt it was necessary.

At the high school site
Issue - The high school teachers were well versed in the current literature and felt very strongly that they needed to adopt a standards-based program if they were to serve the needs of all students and meet the Minnesota graduation standards.

Issue - Ninth grade, which was originally part of middle school, was brought up to the high school level, and the high school teachers felt this was the best place to initiate the new math curriculum.

Issue - Teachers of all grade levels expressed the desire for enhanced and on-going training. The teachers believed it would be especially helpful to have follow-up sessions where they could address questions after they had had some experience teaching the program.

THE EARLY IMPLEMENTATION PROCESS

The high school teachers were the first to begin implementation of the new math curriculum, *Core Plus*. Initial implementation by teachers in grade nine occurred in the fall of 1998. Each year, for the next three years, succeeding grades were added. Implementation at the middle school began in 2000. The middle school (grades six through eight) teachers were expected to begin implementing *STEM*, the middle school curriculum selected, in the fall of 1999 at the seventh and eighth grades. *STEM* was implemented at sixth grade the following year, 2000. The transition was thought to be smooth as many of the teachers are more recent graduates and have either received integrated math curriculum training or shared a philosophical enthusiasm for this type of mathematics program. Teachers at middle and high school are enjoying the benefits of teaching with an integrated program but still struggled with unfamiliarity with the new conceptual approach to teaching mathematics.

Elementary teachers were considering curricula at this point and the date of implementation was as yet to be determined.

Major implementation activities - Four major types of implementation have occurred to date. They vary by school grade level and by implementation year.

1. Three days of initial training of all secondary teachers, in *Core Plus 1*, the summer prior to the fall school year, summer 1998. Training was provided by *Core Plus* professionals who were invited into the school. The following summer, 1999, three additional days of training were be offered for *Core Plus 2*, and three days for *Core Plus 3* summer, 2000. Middle School teachers received two days of training before school started in the fall. They also met for three and one-half days during the school year to discuss teaching issues.

Variation: The training sessions varied by school levels in terms of the amount of experiential immersion in the curriculum versus planning of teaching lessons, assessment, and use of equipment such as graphing calculators.

> *It kind of gave me an overview of how the curriculum worked. It gave me a feel for how to set up lessons and how to assess the children.*

> *Just going through it, it actually made me feel a little more comfortable about what I was going to need to do.*

1. Parent education. The parents were not informed about the decision to adopt the new math curricula. They were introduced to the concept after implementation began at student-parent-teacher conferences.

2. Common time for teachers to meet and interact. The school schedule at the high school was adjusted to afford teachers a common meeting time once per quarter.

> *I've been real happy because we have a day each quarter where we get a chance to meet. And so all the Core teachers get a sub for the day and talk things through.*

3. Organized consultation and support. The high school principal is very supportive of professional development and encourages teachers to attend workshops of interest. Most people have attended the workshops and conferences that they have wanted to. Many go to state and national conventions through SciMath.

> *I think the support on both ends has been pretty good ... moneywise and support-wise. We have a real tight sub situation. We could probably fund just about any conference a math teacher wanted to go to.*

KEY PLAYERS - District is in its fourth year of implementation. Classroom observations suggest most teachers are enjoying the new math curriculum but feel that there may be a concern for special education students and students with other special needs. Teachers find the workload has increased, and that they must use alternate teaching and grading styles. They are pleased with the students' response to the program. The teachers remain the main implementers of the new math curriculum, and experienced, senior teachers offer mentoring to new hires.

MAJOR IMPLEMENTATION ISSUES - Both common and unique issues have emerged at the middle school and high school levels. In some instances the issue has yet to be addressed. Common issues and actions to date include:

Issue - A number of key staff, including paraprofessionals, substitute teachers, and especially the special education staff, were not involved in the initial training sessions and therefore have not been able to support the new mathematics initiative as needed.

Issue - Parents have not been involved in the whole of the curriculum adoption process, thus parents indicated the following concerns regarding the new curriculum. School staff at all levels recognize the need to assist parents but have yet to develop any systematic strategies to date.

- They do not know how to help their students at home, as they are more confident with the materials of a traditional mathematics curriculum.

- Parents also have shared with teachers some concern about their children's ability to apply the new knowledge and succeed.

> ***There could have been something in the newsletter or something going out. In some ways, it has been a shock for our middle school parents. There could have been an article in the paper about the new math and something proactive.***

Issue - There has been an growing realization that successful implementation requires adequate time to be fully developed, appreciated, and for significant systemic change to occur.

Issue - On-going professional staff development must remain a priority. Teachers at all grade levels expressed interest in additional training especially after they had some familiarity with the curriculum.,

Specifically at the high school site

Issue - There is a strong concern with how to assess the students. Curricular materials do not appear to contain adequate instruction on how to assess levels of learning.

Issue – There were several issues that surrounded student assessment.

> *We did not do enough sharing of how do we score the students' work? We are not real standard across our staff as to what is given.*

> *The assessments that came along with Book 1 were not weak, but I was not satisfied. That was a common complaint.*

Issue - There is concern with curriculum materials especially calculators.

> *The school invested in I don't know how many calculators, maybe 100 calculators for students who couldn't afford one, to borrow one for the school year.*

Issue - High school teachers are concerned with how the implementation of Core Plus will affect weaker and special education students.

> *A lot of the special ed kids I have are great problem solvers but not good readers and the reading has hurt them.*

> *I think for some of the kids who are on the lower spectrum of the academic ability, and it's maybe not even their mathematic ability but their interpersonal skills and things like that, that are impacting their ability to do well in a Core program.*

IMPACT ON TEACHER ATTITUDES AND INSTRUCTIONAL PRACTICES

At this stage of the implementation, it is evident that teachers are experiencing learning anxiety and are having to deal with the extra work required with the new program. Teachers commented:

> *When you are teaching a new curriculum, you are one day to one week ahead of the kids. Throw on top of that the fact that you teaching three to four preps, and you realize how much time the teachers are putting in.*

> *If you look at the teachers teaching Core, I think you'll find that it takes all of them a little bit of transition time. And some of them need some staff development in areas that would help them get going on Core.*
>
> *It's not terribly difficult, but it's new, so I have to spend some time. I have to get some props ready and I have to lead them. It happens enough that I have a lot of extra work to do.*

Also evident is the magnitude of change that teachers must deal with in terms of how they themselves learned mathematics, how they learned to teach it, and how their practice has changed to support the new curriculum. And teachers are experiencing both the benefits and challenges of the new curriculum in their classrooms.

> *So I try to reach all the kids which is exhausting, but that's been one of my pushes. It's easy to teach the ones that really want to go and are accelerated, but the other ones, it's not. But it's very hands-on, so I think that helps a lot.*
>
> *Actually the biggest change was putting the ball in the kids' court.*
>
> *The drill & skill might be part of the hour, but it will not be all of it. The other piece that I am enjoying, is the real life application, the hands on, and the problem solving.*

Teachers articulated the new burdens that the reform curriculum places on the children.

> *I think the biggest challenge is it's different, and it is difficult trying to get everybody to think on a different level. I think it's particularly tricky because you're actually asking the students to take a lot more responsibility for what they learn. And some of them are real anxious.*
>
> *Another piece is being able to change the mindset with what kids need to know. You can give kids the skill to do a problem, but it was hard for them to realize that they had to be bumped up to a real life application level.*

At the same time, for most teachers, the new curriculum has reinforced where they were going in their practice.

> *I was having the kids involved, but I was still sort of doing the traditional lecture. It was probably about half and half. And now... I do very little lecture and the kids do all the work.*
>
> *It was the most fun I had teaching out of all the years I taught. I think the students liked it. The teachers were so excited! It took courage for them to get out of their comfort zone!*
>
> *It was a key concern to educate, not just the kids that were engineer-bound or pre-med or the real math-science-driven kids, but that it was an unfair curriculum for the general student.*
> *I tended to be fairly hands-off even before. I tended to try to take problems from the book, maybe, and put them up front instead of necessarily starting to lecture directly.*

Teachers are also starting to make some preliminary observations of the impact of the new curricula on their students.

> *I think just seeing the success rate that kids have. I know I've had fewer students fail than ever. All of a sudden they're understanding.*

> *I think that the behavior and motivation in math class has changed for the positive. I think the kids are working harder. We get a lot more homework assignments in.*
>
> *I see a lot more students being successful because they're learning a lot more about problem solving.*

OVERALL SITE SUCCESSES TO DATE

- Teachers report that they like using the reform curricula. Teachers say that they are excited by the new program.

- Teachers report that there is a move on their part to fill more of a facilitative role for the students as this encourages more group interaction, sharing amongst the students, and, in the teachers' opinion, leads to improved higher level thinking skills.

- Teachers note that students seem much more engaged with math education and many are opting to enroll in four years of math.

> *I think that the behavior in math class and motivation in math class has changed for the positive. Some of that motivation is just different younger teachers doing things differently and teachers that have come in with either a background in Core or a real interest and willingness to get into it.*
>
> *The strength of this is for kids to wrestle with the material and to come up with the mathematical meanings and ideas on their own. But I've also heard a lot of kids say, 'Wow, I really like this,' and 'This is the first time I get math. This is the first time I've ever been successful at math.'*

- The new curriculum provides a more standards-based approach to math education needed to fulfill the Minnesota graduation standards.

OVERALL CHALLENGES THAT REMAIN

- There is a continuing need for organized follow-up training and support among teachers to assure full implementation of the new curricula, including the assessment of student learning and mastery.

- Teachers need time for active communication with each other in order to initiate common planning and to trouble shoot.

- Parents may have needs that have not been systematically identified and addressed. There is a need to assist the teachers in developing strategies for helping the parents.

- Support staff in the school, including special education, substitute, and paraprofessional teachers, need training regarding the new curricula in order to support its implementation in the classroom and with parents.

- There is a continuing need to assess math curricula at the high school level as new grades are brought on board.

POSTSCRIPT

Comments from the district's curriculum coordinator:

- The elementary school has adopted and begun implementing Everyday Math in 2001. Elementary teachers have received One and one-half days of required training prior to school starting. There were an additional two days offered, which were optional.
- High school teachers using *Core Plus* meet about every 6 weeks for a full day to discuss planning and teaching issues. This year (2001), teachers have commented on how much better prepared the students were for the curriculum. Teachers speculate that this may be a result of their previous year's experience with *STEM* in middle school.
- The high school added *Core Plus 4* in 2001, two teachers are using the curriculum.
- ACT scores rose in math fro 2001. This rise may be attributable to students who have used the standards-based curriculum for the last three years.
- High school teachers have added supplemental material to algebra courses.
- Math teachers want to meet with the science teachers to make sure that the math curriculum is meeting the science curriculum's needs. Those secondary teachers are planning a meeting with SciMath sometime this year.

DISTRICT 2 PROFILE

BACKGROUND AND SETTING

District and site characteristics - The district is a larger inner ring suburban district that finds itself in the midst of great flux. The student population is growing, and becoming more diverse both racially and economically. The district also finds itself in the midst of a widespread staff turnover, with many experienced teachers preparing to retire. Because of a strong special education program, the district attracts a large proportion of its students in open enrollment. Math has always been a district priority, and thus, a strong curriculum leadership model was developed which includes a district math coordinator, secondary math department leaders, and an elementary math curriculum committee. The recent adoption of statewide graduation standards, coupled with math's turn in the five year curriculum review cycle fuelled a staff that were already interested in providing an integrated, learner-centered math curriculum. Prior to the current mathematics adoption the district used no common mathematics curriculum.

District 2

Location	Suburban
Enrollment	8326
Percent eligible for free or reduced lunch	10%
Percent with limited English proficiency	5%
Student mobility	21%
Percent enrolled in special education	10%
Percent passing Grade 8 Basic Skills Test	Reading 89% Math 82%

Source: Minnesota Department of Children, Families & Learning. 2001. Data Center.

THE CURRICULUM ADOPTION PROCESS

The decision to adopt new mathematics curricula was initiated by the school district administrators including the superintendent and principals at the point this subject area came up in the regular curriculum review cycle. The curriculum coordinator had a strong hand in shaping the adoption process, although final choices of curricula at the elementary, middle and high school levels may be attributed to the teachers.

Major Elements of the Adoption Process - The adoption process varied among each grade level band. For example, the elementary school took one year, middle school took two years, while the high school implementation took three years. The adoption process included four major elements with some variation across the elementary and secondary sites:

1. Creation of a new math committee was composed only of teachers. The committee's mission was to review and pilot many of the NSF math curricula. Committee members were selected from each grade. Attention was paid to addressing special education needs when reviewing curricula.

   Variation - Programs were piloted in over 30 classrooms at the elementary grades. The math committee was afforded great autonomy. Adoption was K-12 and teachers on the committee selected curricula for all grades.

2. Textbook representatives visited the teachers on-site to introduce math products and programs.

3. The staff brought in teachers from other schools who could model the new curricula.

   Variation - The visits varied in terms of which teachers participated, which grade level, and which curriculum were observed.

4. At all grade levels the committee members selected the curricula. All teachers had input initially, but the final decision was made at the committee level.

   Variation - Unanimous decision at the elementary level.

Key players -The superintendent encouraged participation in selection of new math curricula when the review occurred. He had placed his trust in the previous math committee chairperson, and supported the new curriculum coordinator and the teachers who sat on the committee to select appropriate curricula. The superintendent and the math curriculum chairperson were the key influences during the adoption process. The district school board and principals were supportive but were not seen to drive the process. Their roles were to represent the community voice and to provide logistical assistance in organizing substitute teachers. The superintendent, in particular, wanted to see reform that would result in improved student test scores in mathematics and would enhance the reputation of mathematics in the district. Two other categories of players from outside the district had some influence on the adoption process, the curriculum publisher representatives who provided the teachers with samples of curricula, and teachers from the other school districts who shared their teaching experiences using the standards-based curricula.

KEY ISSUES DURING THE ADOPTION PHASE

There were some common issues that arose for elementary, middle, and secondary school that included:

Issue – This district has traditionally supported ability grouping of students. Parents of high potential children in the district are concerned that their children will not be challenged sufficiently.

Issue - Teachers and administrators are hesitant about using an integrated math program with less successful students, those with special education needs, and ESL students who will have difficulty with reading.

Issue - There was a concern that the program was difficult for students and lacked content coverage in certain subjects. Teachers supplemented topics when they felt it was necessary. This became especially true of teachers in the elementary grades who used supplemental materials for computational skills.

Issue - Teachers of all grade levels expressed the desire for enhanced and ongoing training. The teachers believed it would be especially helpful to have follow-up sessions where they could address questions after they had had some experience teaching the program. Ongoing sessions on content would be particularly valuable. Teachers hope a staff development grant, which is pending, will be funded.

At the elementary school site
Issue - Piloting two programs in the classrooms.

> *We piloted Investigations and Everyday Math. Just K-6. We had a group of people that piloted Everyday Math and really liked it. And we had a group of people that piloted Investigations and they really liked it. And so we came together and we had really positive results from this one and really positive results from that one. And so then it did make it difficult. I would have had both groups do both, so that you could compare the two programs a little bit easier.*

Ultimately, a unanimous decision in favor of Investigations was reached.

Issue - Cost was another factor.

Investigations didn't have as much consumable, and was less costly for implementation.

At the high school site
Issue - Concern over materials especially graphing calculators.

There were insufficient materials. There were no class sets of graphics calculators purchased. So then there was a huge expenditure just in materials after the implementation was in place. So my concern is: getting the graphing calculators and the ninth grade kids who can't afford them into their hands.

THE EARLY IMPLEMENTATION PROCESS

The elementary (K-6) teachers were expected to begin implementation of Investigations in the fall of 1998. The middle school (7-8) teachers were expected to begin implementing *CMP* in seventh grade in the fall of 1998, and in eighth grade the following year. The high school teachers began implementation at ninth grade with the introduction of *Core Plus 1* in fall 1998. This was to be followed with *Core Plus 2*, and finally *Core Plus 3*. At this point teachers at primary, middle and secondary school were enjoying the benefits of teaching with an integrated program but still struggled with the occasional lack of traditional conceptual guidelines.

Major Implementation activities - Five major types of implementation have occurred to date that vary by school grade level and by implementation year.

1. Teachers of all grades were introduced to the new math program in a one-day workshop provided by the district in the spring prior to adoption. Three days of initial training of elementary teachers and some paraprofessionals including licensed resource teachers and special education staff was held in August prior to the beginning of the school year. Attending the *Investigations* training was highly encouraged, but optional. Staff were given pay or credit for attending. Representatives from TERC (curriculum developer) were invited to the school district to provide the initial training. Grade level meetings were held during the school year to supplement the training.

   All secondary teachers had two weeks of curriculum training the summer before the middle and high school curricula were implemented. The training was provided by teacher trainers through an NSF-sponsored grant, (MASP)^2, Minneapolis and St. Paul Merging to Achieve Standards Performance. Teachers also had curriculum mentors who met with each of them for twenty hours during the first year of implementation. Follow-up training sessions were held throughout the school year. All secondary teachers attended a week of follow-up training the summer after implementation. Secondary teachers received 130 hours of staff development toward the implementation of *CMP* and *Core-Plus*. Teachers were given pay or credit for their participation in initial and follow-up training.

   Variation - The training session varied by curriculum session in terms of the amount of experiential immersion in the curriculum versus the planning and teaching of lessons, assessment and use of equipment such as graphing calculators.

2. Initial implementation by teachers in K-7 and 9 occurred fully in the fall of 1998. With some discomfort they dropped their use of traditional curricula. Teachers occasionally feel the need to supplement the curriculum.

3. Parent education. There was an excellent schedule of informational meetings for the parents during the year and the summer before the adoption. Parents received newsletters informing them of the new curriculum adoption.

   > *The elementary had an all Investigations night the year prior to adoption. All grade levels held curriculum nights.*

4. Common time for teachers to meet and interact.

   > *At the elementary meetings were held once a month – every six weeks. There were late start days and one was devoted to math. The middle school held frequent (sometimes daily) informal meetings. Weekly meetings were common at the high school.*

5. Organized consultation and support. The principals are very supportive of professional development and encourage teachers to attend meetings and to watch other teachers teaching. Most people have attended the workshops and conferences that they have wanted to.

   Variation - There was a perception that hirings included teachers, who were kind of math whizzes for a couple of years to help out with this change. Special ed teachers for the first couple of years came into our classroom and team taught classes. So there was a special ed teacher who was really good at seventh grade math, and one who really knew the Core and one who really knew the eighth grade math so when the special ed kids needed assistance there was a resource person available for them.

Key players - District is in its third year of implementation. Classroom observations suggest most teachers are enjoying the new math curriculum but feel that there may be a concern for special ed and struggling students. They find the workload has increased and that they must use alternate teaching and grading styles. They are pleased with the students' response to the program. The teachers remain the main implementers of the new math curriculum and make use of each other's knowledge gained at various workshops.

Major implementation issues - Both common and unique issues have emerged at the elementary, middle school and high school levels. In some instances the issues have not yet been addressed.

For all grades
Issue – Teachers in the district stated that they wanted to maintain flexibility with the curricula and have the freedom to supplement it.

> *We need to be careful about the fact that curriculums are not always complete and they don't always meet the needs of all kids. There is some room for latitude in how you view what kids need to learn and know, and how they do it.*

Issue - There is a great concern for ESL and struggling students at all grades. Teachers feel the need to provide support for ESL students or any who are struggling with reading.

Issue - Curricular materials do not appear to contain adequate instruction on how to assess levels of learning. This has resulted in frustration and extra work for the teachers.

Issue - The parents have indicated some concern with the new math curricula. They are unsure of how to help their students, as they cannot see the sequence required and are used to a traditional math program. They are uncomfortable with how their students will apply their knowledge and succeed.

Issue – A concern felt by the parents of high potential students is that their children are not being challenged sufficiently.

School staffs at all levels are sensitive to both of the above issues and want to help parents. To date, there has been no implementation strategy that is centered on instructing the teachers on how to help the parents.

Issue - There has been an escalating realization that successful implementation requires adequate time to be fully developed, appreciated, and for significant change to occur.

Issue - Ongoing professional staff development must remain a priority. Teachers at all grade levels expressed their concern with their initial training. There is a feeling on the part of administration that they skimped on initial training. They all agreed that there is a need for additional training especially after the teachers had some exposure to the curriculum. Teachers also felt that administrators including principals should have integrated math training as well so that they would be helpful to the teachers especially with their interactions with parents.

At the elementary school site
Issue - There is a serious concern with lower computation scores at the elementary level. Scores have dropped significantly in computation across the district. There is a question of how to maintain the strengths of the new math program and still accommodate the computation issue.

At the high school site
Issue - There is concern about the unavailability of curriculum materials especially calculators.

> *There were no class sets of graphics calculators purchased. So then there was a huge expenditure just in materials after the implementation was in place. So my concern is getting the graphing calculators and the ninth grade kids who can't afford them into their hands.*

IMPACT ON TEACHER ATTITUDES AND INSTRUCTIONAL PRACTICES

At this stage of the implementation, it is evident that teachers are experiencing learning anxiety and are having to deal with the extra work required with the new program. Teachers reported:

> *The first year took at lot of prep in terms of making all of the things and collecting things. And I think that was really frustrating for people.*
>
> *I think the biggest challenge was for the teachers who realized that it was going to take a lot of work to be successful.*
>
> *I do spend far more time correcting.*

Teachers say that they spend more time on ongoing student assessment and pacing.

> *They spent an awful lot of time on assessment. In follow up professional growth kinds of things, that's probably the issue that they spent more time on than anything else.*

> *So for assessing, it takes a terrific amount of time. Then to tell the parents how you assessed is also much more time consuming.*

Also evident is the magnitude of change that teachers must deal with in terms of how they themselves learned mathematics, how they learned to teach it, and how their practice has changed to support the new curriculum.

> *You must be organized in your planning and with your materials. You also have to help the kids be organized, too, or it would be chaos as far as leaving enough time for materials to be picked up. This takes time.*
>
> *I had to change my teaching style from giving a procedure, an algorithm into a discovery style and then having the kids summarize but making sure they got it. Doing the leading questions. Not that you didn't question before, but it was a different type of questioning.*
>
> *Learning to listen to the kids was the biggest thing—really listen to what they were telling me and not to make any assumptions when they were talking. Classroom management goes along with it too.*
>
> *I am concerned that kids stay on task and stay working. I find it more difficult to keep them on task when they are in groups than when I am walking around the classroom.*
>
> *The working in groups is something that is very different from a traditional math classroom. I really needed to stretch myself to be open to what kids were bringing to the table and to try and make sense of that.*

At the same time, for most teachers, the new curriculum has reinforced where they were going in their practice.

> *When kids come up to me with something I've never seen before, I make a point of telling them I'm going to write it down in my book so I can share it with kids who don't come up with that in the future.*
>
> *I love the higher-level thinking. When kids share their strategies I feel like I am more of a facilitator rather than a teacher.*
>
> *It is a much more positive way to approach math. There are real life situations. It is applied math as opposed to just facts. I supported it wholeheartedly from that point of view.*

Teachers are also starting to make some preliminary observations of the impact of the new curricula on their students

> *The students like it! They are excited! Math is not a threatening thing for them, which is the way math should be. The problem solving that I have seen that kids have come up with is wonderful.*
>
> *What I have noticed with the kids is that they have become incredible problem solvers. That has been one of the biggest changes I have seen in math and the other big change that I have seen in math is that I have not had one kid say this is boring or do we have to do this again?*

They are doing such higher-level thinking right now, higher level mathematics. The number of kids who are completing calculus, whether in advanced placement or not, are far larger than before, so there is also a sense of well being about the district math program.

They develop problem solving techniques and higher order thinking skills. I hear kids saying that math is their favorite subject more than they used to. That positive feeling about it lends itself to greater learning.

OVERALL SITE SUCCESSES TO DATE

- The adoption process appears to have resulted in the teachers developing a strong identity with the reform curricula chosen.
- Teachers report that they like using the reform curricula. Teachers suggest that they are excited by the new program and feel that it has made math more interesting for their students. They find students much more relaxed and positive in their approach to mathematics.
- Teachers report that there is a move on their part to fill more of a facilitative role for the students as this encourages more group interaction, sharing amongst the students; and in the teachers' opinion leads to improved higher level thinking skills.
- Teachers note that students seem much more engaged with math education, and many are opting to enroll in four years of math.
- The new curricula provide a more standards-based approach to math education needed to fulfill the Minnesota graduation standards.

OVERALL CHALLENGES THAT REMAIN

- There is a continuing need for organized follow-up training and support among teachers to assure full implementation of the new curricula, including the assessment of student learning and mastery.
- Teachers need time for active communication with each other in order to re-ignite their enthusiasm, and trouble shoot.
- Parents may have needs that have not been systematically identified and addressed. There is a need to assist the teachers in developing strategies for helping the parents.
- There is a need to publish the data in order to support or refute the integrated math program.
- There is a continuing need to assess math curricula at the high school level as new grades are brought on board.
- The one option teachers have favored is a common planning time during the school day. They have also expressed a desire for more training.

POSTSCRIPT

The district did receive a Best Practice Seminar Grant through CFL. We were able to offer 32 hours of staff development to 75 elementary teachers in content (Number Sense and Shape, Space and Measurement), instruction and assessment. The seminars were held on six days (outside the school day) from February through May 2001. Participants were actively involved in model lessons, wrote lesson plans, tried them in their classrooms, brought back student work, looked at the work to inform instruction, worked on developing rubrics for assessments and completed assigned readings. As a result, teachers reported they were more confident in solving problems themselves and in teaching the curriculum.

This summer, many teachers new to the district took advantage of summer training offered in both *Investigations* and *CMP*. There will be follow-up meetings for new teachers throughout the school year. All K-5 teachers will have an additional 8-10 hours of staff development during this school year related to *Investigations*.

This fall, the elementary math committee published a Parent Handbook for Investigations and is working on a Computation Manual for teachers. The Computation Manual will outline strategies for teaching number operations consistent with the curriculum and with connections to the curriculum, as well as an appendix on strategies for teaching basic facts.

The secondary teachers continue to meet during their collaboration time and during the summer to work on grade level or course teams to implement MN Standards performance tasks. This year secondary teachers will have an all-day math staff development day in November.

DISTRICT 3 PROFILE

BACKGROUND AND SETTING

District and site characteristics – The district is a small district located in greater Minnesota. District officials describe student enrollment as growing at a slow but steady pace. A shared decisions culture is said to exist within the district, and community supports the schools both financially and emotionally. Mathematics education has become a central academic focus for the district. District administration and teachers were not satisfied with the basic skills test results particularly in mathematics. Both the district's superintendent and curriculum director felt the need to take some action. Some teachers were interested in connecting curriculum to the standards and implementing an NSF-funded standards-based mathematics curriculum to help lower achieving students. They also supported the efforts of the superintendent and the curriculum coordinator to adopt a new curriculum. These actions were also fuelled by the recent promotion of national and statewide graduation standards. The result was that the curriculum adoption cycle was accelerated by one year to allow the new mathematics implementation to occur.

District 3

Location	Greater MN
Enrollment	1,681
Percent eligible for free or reduced lunch	9%
Percent with limited English proficiency	0%
Student mobility	7%
Percent enrolled in special education	9%
Percent passing Grade 8 Basic Skills Test	Reading 85% Math 79%

Source: Minnesota Department of Children, Families, & Learning, 2001. Data Center.

THE CURRICULUM ADOPTION PROCESS

The decision to adopt new mathematics curricula at the high school was initiated by the curriculum coordinator and math department head. A seventh grade middle school teacher was instrumental in initiating discussion of adoption in the middle and elementary school. The elementary school was the last to adopt as they had recently adopted the new curriculum in language arts.

Major Elements of the Adoption Process - The adoption process for elementary lasted two years and began one year after the middle and high schools. Middle school adoption lasted one year while the high school implementation lasted three years. The adoption process included four major elements, with some variation across the elementary and secondary sites:

1. Creation of a new math committee for elementary - Elementary teachers represented their colleagues by studying the curricula and sharing information with each other. At the elementary level, all teachers were involved in initially selecting the curriculum to align materials with the state standards. Several elementary teachers piloted individual units of the new curricula. Once the committee was formed, it became their responsibility to discuss and present colleagues with information. Teachers had confidence in the committee. A vote was held to decide which curriculum was to be adopted, and *Investigations* was chosen in a 17-1 vote.

Variation - Adoption at the high school occurred after one in-service session during the summer that was organized by the curriculum director. Teachers were not directly involved in the decision, as only the newly hired teacher would be teaching the new integrated program that first year of implementation. Adoption at the middle school was driven by the seventh grade teacher and curriculum director.

2. Textbook representatives provided the curricular materials.

3. State and SciMath Minnesota staff visited the school and assisted the district in the adoption process. SciMath Minnesota also informed the district of other districts and schools implementing the NSF-funded curricula. Several committee members and teachers visited these sites.

   Variation - The visits varied in terms of which teachers participated, which grade level, and which curriculum was observed.

4. At the elementary school the teachers made the final selection decision.

   Variation - It appears that the middle and high school selection decisions were made by the curriculum director and math department head.

Key players - The superintendent was not involved in the high school adoption, and played a tangential role in the elementary adoption. One middle school teacher, the curriculum director, and the high school mathematics department head facilitated the process of study, decision-making, and implementation. The curriculum director was a key influence during the adoption process. The school board and principals were supportive but played only a minor role the process. Their roles were to represent the community voice, and to provide logistical assistance such as in hiring substitute teachers. Two types of players from outside the school district also had some influence on the adoption process, including the salespeople from the curriculum publishers who provided the teachers with examples of curricula and the teachers from the other school districts who shared their experiences of teaching the new curricula.

KEY ISSUES DURING THE ADOPTION PHASE

There were some common issues that arose for elementary, middle, and secondary school that included:

For all grades

Issue - There was a strong concern that the program was too difficult for students who frequently struggle in mathematics – those for whom the program was intended.

Specific to the elementary school site

Issue - There, several elementary teachers disagree with the philosophy of math class tracking.

Issue - Once the decision was made to adopt *Investigations*, the district was fully prepared to purchase all relevant materials to support the program. However, frustration occurred when the materials failed to arrive when implementation began.

Specific to the high school site

Issue - How to connect students to practical applications, while still maintaining the content in algebra and geometry.

Issue - Concern for new teachers who may not be well-prepared to teach the new math curriculum. Some high school teachers remarked that they felt unsupported both financially and emotionally.

Issue - Some teachers felt there was a lack of background information about the curriculum.

Issue – When materials or information seemed insufficient to teachers in specific areas, teachers supplemented topics.

Issue - Teachers were not involved in the decision-making process of the math curriculum selection. Not all teachers agree with the new program and some are resistant to its use. Only one newly hired teacher was involved in the program the first year of adoption, and this resulted in her feeling isolated and targeted by the teachers who did not agree with the adoption decision.

Issue - It is difficult to maintain two streams of math education in the high school. Having both a traditional and integrated math program has led to frustration and divisiveness amongst administrators, teachers, and parents.

THE EARLY IMPLEMENTATION PROCESS

The elementary (K-5) teachers were expected to begin implementation of *Investigations* with a few selected units in the fall of 1998. By the following year it was expected that *Investigations* would be completely implemented. The elementary adoption was delayed one year behind that of the middle and high school. The middle school teachers (grades six through eight) were expected to begin implementing *CMP* in the fall of 1997. One high school teacher began implementation at ninth grade with the introduction of *Core Plus 1*. This was to be followed annually with *Core Plus 2*, and finally *Core Plus 3*. At this point teachers at primary, middle and secondary school were enjoying the benefits of teaching with an integrated program but still struggled with the occasional lack of traditional conceptual guidelines.

Major implementation activities - Five major types of implementation have occurred to date, that vary by school grade level and by implementation year.

1. Four days of initial training of all elementary teachers and some substitute teachers on-site by a State trainer followed a few months later by visits to the various grade teams. During the first year of implementation, elementary teachers were given a day off each time they prepped a new unit. The teachers were delighted with this common preparation time.

Variation - At the high school only one teacher who was a new hire was sent for three days of *Core Plus* training in August. The instructor was a teacher from another school district who had been teaching the program. Middle school teachers were sent to Michigan State for training in the summer.

Variation - The training sessions varied by school levels in terms of the amount of experiential immersion in the curriculum versus planning of teaching lessons, assessment, use of the textbook, and use of equipment such as graphing calculators. At the elementary level this also included game activities.

2. Initial implementation by teachers in grades six through nine occurred full out in fall 1997. With some discomfort they dropped their use of traditional curricula. Staff occasionally feel the need to supplement the curriculum.

Variation - At the high school, some teachers are continuing to investigate alternate curriculum supplements. At the elementary level, the program has been supplemented with *Mad Minutes* and algorithmic supplements.

3. Parent education. Parents were invited to several meetings to discuss the new curricula.

Variation - The elementary school hosted a parent open house in the fall where each grade level was given an opportunity to speak.

4. Common time for teachers to meet and interact. At the elementary level, grade level meetings occur on a weekly basis. These meetings are facilitated by the fact that each grade level has the same preparation time.

Variation - The high school does not have regularly scheduled meeting times, however, many informal meetings are organized. The high school used to meet regularly with the middle school but no longer does.

5. Organized consultation and support. The curriculum director in particular and the principals are very supportive of professional development and budget for it. Teachers have attended workshops and conferences when interested.

Key players – The district is in its third year of implementation. Classroom observations suggest that several teachers are enjoying the new math curriculum but feel that there may be a concern for poorer students. Teachers say the workload has increased and that they must use alternate teaching and grading styles. Teachers also say they are pleased with the students' response to the new curriculum. The teachers remain the main implementers of the new math curriculum and make use of each other's knowledge gained at various workshops.

Major implementation issues - Both common and unique issues have emerged at the elementary, middle school and high school levels. In some instances the issue has yet to be addressed. Common issues and actions to date include:

For all grades
Regarding the overall attitudes towards the implementation, stakeholders raised the following concerns.

Issue - There is a concern that complete implementation was not occurring. There was one suggestion that the curriculum director should attempt to assess the degree of implementation. The administrator should be trained on how to assess the implementation process and how to guide the teacher's who are struggling with implementation.

Issue - Teachers of all grade levels expressed the desire for enhanced and on-going training. The teachers believed it would be especially helpful to have follow-up sessions where they could address questions after they had had some experience teaching the program.

Issue - There has been some concern with the lack of involvement of the school principals.

Issue - A number of key staff, in-school tutors and special education teachers, for example, have not been able to effectively support the new math initiative because of their lack of involvement in the initial training sessions.

Issue - There is a desire to gain a stronger, more faithful teacher following regarding the curriculum.

Issue - There has been an escalating realization that successful implementation requires adequate time to be fully developed, appreciated, and for significant change to occur.

Issue – Teachers stress that on-going professional staff development remain a priority. Teachers at all grade levels expressed their concern with their initial training. They all agreed on a need for additional training especially after they had some familiarity with the curriculum. The administrators agree that further professional development should be available.

The two track system
Issue – The district uses a two track system for math at the high school and middle school. This has sent mixed messages to college-bound students who tend to follow a traditional track and other students choosing the integrated program.

Parent concerns
Issue - The parents have indicated some concern with the new math curricula such as lack of a textbook. Many do not understand the need for the change and lack the confidence to be able to help their children. School staff at all levels are sensitive to this issue and would like to assist the parents but no central strategy yet exists.

Specific to the elementary school site
Issue - Several teachers are concerned with separating students based on ability.

Specific to the high school site
Issue - *The new curriculum was* implemented by only one newly hired teacher. And that teacher was appointed to the position rather than voluntarily selecting it. The other teachers were not involved in the adoption and were detached from the new teacher leaving her feeling isolated and without support.

Issue - There was difficulty preparing for the upcoming implementation years as teachers did not have access to new books until they were ordered shortly before the new school years.

Regarding the attitudes and climate towards the new mathematic curriculum.

Issue - There is a feeling that the principal has remained a spectator, and this has resulted in a distancing of teachers from the curriculum.

Issue - There is serious concern that a common belief system is lacking, and that until new activities intentionally build consensus, there will be a continued struggle with the two track system.

IMPACT ON TEACHER ATTITUDES AND INSTRUCTIONAL PRACTICES

At this stage of the implementation, it is evident that teachers are experiencing learning anxiety and are having to deal with the extra work required with the new program. Teachers commented:

> *Last year it was difficult for everybody, because it was all new. There were a lot of things that I had to learn.*
>
> *You certainly need to read ahead so you know where you are going. The first year especially, I would have to really know where I was going in order to facilitate the activities with the kids.*
>
> *The first year, they are going to need more time to implement the NSF curriculum.*
> *No doubt this curriculum is more difficult. It is a different way of teaching. I was frustrated with grading the homework because I had so much homework to grade all the time, I just couldn't keep up.*

Also evident is the magnitude of change that teachers must deal with in terms of how they themselves learned mathematics, how they learned to teach it, and how their practice has changed in order to support the new curriculum:

> *We are having a hard time pulling away from doing Mad Minute Math things.*
> *I used to do a lot of presentation, then drill, drill, drill. Next, the students had to practice, then give it back to me on a test.*
>
> *With the new structure and grading, everything I had learned in student teaching had just been thrown out the door.*
>
> *The curriculum keeps saying to move on even if the students don't get it. I have a hard time with that, because I am still in somewhat of a mastery mode.*
>
> *In the past, I would have just been standing up at the board. It would have been so much more formal, where now I mingle all hour, working one on one with the groups.*

At the same time, some teachers believe that the new mathematics curriculum has had little affect on their own instructional practice.

> *I have always done group work. I try to encourage less spoon feeding and more discovery.*
> *The math program has been enhanced by Investigations. Before, I felt as if I was instructing them on how to do this process, giving them a page in a book to do as homework.*

Teachers are also starting to make some preliminary observations of the impact of the new curricula on their students:

> *Often my kids will ask whether we can skip language arts and just do math.*
>
> *The interaction of the kids and their partners and the feedback they have given me suggests they are really enjoying the program. It is relevant to them, and it's not just mundane bookwork for them.*
>
> *The most impressive thing to me is the fact that I have kids that thought they were bad at math, that now think they are good at math. That is the most significant improvement that we have had.*
>
> *They are truly understanding math better than if they were in a traditional track.*

OVERALL SITE SUCCESSES TO DATE

- Teachers report that they like using the reform curricula. Teachers suggest that they are excited by the new program and feel that it gives them the opportunity to get to know their students more intimately.
- Teachers report that there is a move on their part to fill more of a facilitative role for the students as this encourages more group interaction and sharing amongst the students, and in the teachers' opinion leads to improved higher level thinking skills.
- There has been documented improvement in both elementary and middle school math test scores. It is anticipated that the achievement test scores at the high school will show a steady rise.

- Teachers note that students seem much more engaged in their math education, and many are opting to enroll in four years of math.

- The new curricula provides a more standards-based approach to math education needed to fulfill the Minnesota graduation standards. Only three years of the integrated math program are needed to fulfill the graduation standards.

OVERALL CHALLENGES THAT REMAIN

- There is a continuing need for organized follow-up training and support among teachers to assure full implementation of the new curricula, including the assessment of student learning and mastery.
- Many teachers remain unconvinced of the value of the new curriculum that has resulted in mixed messages and confusion for students and parents at the high school in particular.
- School administrators seem not to fully support the new mathematics curriculum
- Beginning implementation in the high school with just one teacher has placed a high burden on that teacher and may not accomplish implementation in the manner that administrators and supporters had expected.
- Teachers need more time for active communication with each other.
- Parents have needs that have not been systematically identified and addressed. There is a need to assist the teachers in developing strategies for helping the parents.
- Support staff in the school, including special education, and substitute teachers, need training regarding the new curricula in order to support its implementation in the classroom and with parents.
- There is a continuing need to assess math curricula at the high school level as new grades are brought on board.
- There is a clear need to attain greater consensus about the rationale for traditional and integrated programs at the high school.

DISTRICT 4 PROFILE

BACKGROUND AND SETTING

District and site characteristics – The district is situated in a small community located beyond commuting distance from the Twin Cities. It has always relied on its professional educators to determine school curricula. Adoption of an integrated technology program several years ago alerted staff to the advantages of an integrated mathematics curriculum as well. The statewide graduation standards together with poor student scores on achievement tests provided additional fodder for school staff already interested in providing an integrated, standards-based math curriculum. Prior to the NSF curriculum adoption, the district used a common mathematics curriculum which was accomplished through a curriculum review cycle.

District 4

Location	Greater Minnesota
Enrollment	2,062
Percent eligible for free or reduced lunch	23%
Percent with limited English proficiency	1%
Student mobility	8%
Percent enrolled in special education	11%
Percent passing Grade 8 Basic Skills Test	Reading 82% Math 77%

Source: Minnesota Department of Children, Families & Learning, 2001. Data center.

THE CURRICULUM ADOPTION PROCESS

The decision to adopt new mathematics curricula was initiated by the former superintendent who also filled the curriculum coordinator role, when mathematics came up in the regular curriculum review cycle. High school teachers were committed to the adoption process, while elementary and middle school teachers appear to have been more reticent to adopt. The former superintendent did not consider himself an expert on math curricula but provided a facilitative atmosphere for the teachers to come to a decision about preferred curricula.

Major Elements of the Adoption Process - The adoption process for elementary, middle school, and high school took approximately two years as it was recognized that the adoption was a fundamental change, not a cosmetic change and that that required extra time. The adoption process included four major elements with some variation across the elementary and secondary sites.

1. Creation of new math committees comprised of teachers from elementary, middle, and high school.

   Variation - The math committees were afforded great autonomy. Independent decisions were made as to math curricula adoptions for elementary, middle, and high school. This may in part have been spurred as middle school and high school tried to work together on an earlier adoption, which saw difficulties between the two buildings.

2. Teachers approached textbook representatives at the conferences they attended or by telephone in order to review the various options available. The reps were helpful in suggesting staff in other school districts who could provide the teachers with their experiences using the various curricula.

Variation - Elementary teachers reviewed four curricula, including *Everyday Math*, *Investigations*, *Trailblazers*, and *Mathland*. High school teachers reviewed *Core Plus*, and *Arise*.

3. Teachers visited several school sites that were implementing various mathematics curricula, and approached teachers from outside the district by telephone.

   Variation - The visits varied in terms of which teachers participated, which grade level, and which curriculum was observed.

4. The teachers who served as the grade level committee members made the final selection of mathematics curricula for the elementary, middle, and secondary schools.

Key players - The former superintendent encouraged adoption of the NSF funded standards based math curricula. It was in those parameters that the former superintendent placed trust in the teachers who sat on the math committees to select appropriate curricula. The high school teachers and the former superintendent were the key influences during the adoption process. The high school teachers shared their commitment to adopt an integrated math program with the elementary and middle school teachers who needed much more convincing. The district school board and principals were supportive but not seen to drive the process. Their roles were to represent the community voice and to provide logistical assistance in organizing substitute teachers, and so on. The former superintendent in particular wanted to implement a curricular reform that would result in improved student test scores in mathematics. Two types of players from outside the school district also had some influence on the adoption process, including the sales representatives from the curriculum publishers that provided the teachers with examples of curricula and the teachers from the other school districts who shared their experiences of teaching the new curricula.

KEY ISSUES DURING THE ADOPTION PHASE

There were some issues that transcended grade level or band.

Issues for all grades

Issue - It was extremely important that each grade band be allowed to make their respective decisions independently.

Issue - All school levels felt the need to select the most traditional of the available integrated math curricula.

> *We felt that Investigations was too radical, Everyday Math was more traditional and a better compromise. Core Plus was the more traditional of the two choices. Arise was a little too radical.*

Issue - Teachers of all grade levels expressed the desire for enhanced and on-going training. The teachers believed it would be especially helpful to have follow-up sessions where they could address questions after they had had some experience teaching the program.

At the elementary school site

Issue - The elementary teachers needed convincing before they would admit that they required an integrated math program. They developed a list of what they felt students should accomplish at each grade level. For comfort they adhered to this list when reviewing and ultimately selecting *Everyday Math* with a unanimous vote.

At the high school site

Issue - The curriculum that was selected was not based on a unanimous vote. The *Arise* publishers were not as forthcoming in supplying materials as the *Core Plus* publishers.

Issue - There was a concern that the program was difficult for students and lacked coverage in certain subjects. The teachers supplemented topics if they felt it was necessary.

THE EARLY IMPLEMENTATION PROCESS

The elementary (K-5) teachers were expected to begin implementation of *Everyday Math* in the fall of 1998. The middle school (grades six through eight) teachers were expected to begin implementing *CMP* in the fall of 1998. The high school teachers began implementation at ninth grade with the introduction of *Core Plus 1*. This was to be followed annually with *Core Plus 2*, and finally *Core Plus 3*. At this point teachers at primary, middle and secondary schools were enjoying the benefits of teaching with an integrated program but still struggled with the occasional lack of traditional conceptual guidelines.

Major implementation activities – Three major types of implementation have occurred to date, that vary by school grade level and by implementation year.

1. Initial training - Elementary teachers received two and a half days of training, by grade level, in summer prior to the implementation the following school year. Paraprofessionals were not included in the initial training sessions. *Everyday Math* representatives provided off-site training to the elementary teachers. Secondary math teachers received training of three days duration in the summer prior to each grade adoption. Training was contracted with and provided by an experienced teacher from another school district on-site. All secondary teachers, including those not teaching *Core Plus* the following year, were expected to attend the summer training.

   Variation - The training sessions varied by school levels in terms of the amount of experiential immersion in the curriculum versus planning of teaching lessons, assessment, and use of equipment such as graphing calculators.

2. Follow-up training - Elementary staff received a follow-up day in the winter devoted specifically to mathematics, which was wonderful, because the teachers had taught it long enough to know what they did not understand.

3. Organized consultation and support - The superintendent is very supportive of professional development. Most teachers have attended the workshops and conferences that they have wanted to. Secondary teachers comment that there are many opportunities to attend meetings and participate in workshops, SciMath meetings, and math users' groups in the summer months.

Key players - District is in its third year of implementation. Classroom observations suggest most teachers are enjoying the new math curriculum but feel that there may be a concern for poorer students. They find the workload has increased and that they must use alternate teaching and grading styles. They are pleased with the students' response to the program. The teachers remain the main implementers of the new math curriculum and make use of each other's knowledge gained at various workshops.

Major implementation issues - Both common and unique issues have emerged at the elementary, middle school and high school levels. In some instances the issue has yet to be addressed. Common issues for all grade levels include:

For all grade levels
Issue – Teachers commented that a number of key staff members, including paraprofessionals, substitute teachers, and special education staff, have not been able to effectively support the new math initiative because of their lack of involvement in the initial training sessions.

Issue - Initial implementation by teachers in K-9 occurred fully in the fall of 1998, with some discomfort they dropped their use of traditional curricula. Staff occasionally feels the need to supplement the curriculum.

Issue - Common time for teachers to meet and interact in an ongoing way. Elementary teachers in particular have complained that they were not provided with common meeting times but simply engaged in hallway conversations. The district had in place a late start schedule that provided K-12 teachers with curriculum collaboration time ranging from 10-14 ½ hours. Elementary teachers have an additional two and one half days for curriculum coordination.

Issue - The curriculum committee initially approached parents to gather input on curriculum choices. For example, parent letters, which the publishers provided, were sent out early on in the process. Parents suggested they would prefer to leave the decision of the mathematics adoption with the teachers who they considered the experts. Once the adoption decision was reached however, the parents were not provided with a lot of information. Some information was provided in annual reports, other information was provided through the school board.

Issue - While parents have not raised too many concerns with the new math curricula, some are unsure of how to help their children. Teachers and administrators are sensitive to these issues and would like to assist the parents. To date, there has been no implementation strategy that should center on instructing the teachers on how to help parents.

Issue – Teachers are concerned with how to conduct ongoing student assessments. The new curricula do not appear to set stringent guidelines on assessment, and, thus, teachers find themselves at different levels with application and understanding of assessment.

Issue – There is a desire among teachers for on-going professional staff development remain a priority for the district. Teachers at all grade levels agreed on a need for additional training especially after they had some familiarity with the curriculum.

At the elementary school site
Issue - There is a concern at the elementary school with the lack of release time for teachers to use to plan together.

At the high school site
Issue - Concern for poorer students. Problems with large number of students dropping out of third year of *Core Plus* specifically during the trigonometry unit.

> *The kids that dropped, to be honest, I just don't see where in the heck they would have gotten it. The difference between the good and the poor students just keeps growing. They are just not capable of doing this stuff.*

Issue - Meeting the standards and keeping pace with other instructors.

> *We're stressed to get through the curriculum so that we can meet the standards. We are really pushing. We have to in order to get to the point where they're going to meet the standards. We*

especially notice now with three of us teaching it, at the semester, we are going to have to be at the same place because the students are going from one to the other.

Issue - Concern that students will be missing some material, a feeling that there is a need to supplement material.

> *Not having taught it for two years, and getting them this year, they are lacking in some of the skills.*

IMPACT ON TEACHER ATTITUDES AND INSTRUCTIONAL PRACTICES

At this stage of the implementation, it is evident that teachers are experiencing learning anxiety and are having to deal with the extra work required with the new program. Teachers commented:

> *We did things we were told not to do. I have not taught the first two years of Core Plus, but I am teaching the third year. I think I was probably stressed.*
>
> *Teachers felt it was a lot of work the first time through Core 1 and 2, and wanted to stay teaching it instead of moving to Core 3.*

Also evident is the magnitude of change that teachers must deal with in terms of how they themselves learned mathematics, how they learned to teach it, and how their practice has changed to support the new curriculum.

> *We were trying to teach too many things and teaching to a shallow level of understanding. We have artificially segmented the math curriculum into those subjects that have persisted over the last 100 years. That needs to change.*
>
> *I really feel that the working independently has helped rather than the 80% lecturing I was doing. I still do more than I should, but I don't do 80% anymore.*
>
> *Assessment has become more informal, and new pieces such as observational parts of assessment seem foreign, thus, each teacher is at a different level with assessment.*
>
> *If you let them go with an investigation, task management becomes a problem. So I probably do one or two of the investigations. And after 10 minutes call them back; so I stay pretty traditional there. I do not do as much cooperative learning as they would probably recommend.*

At the same time, for most teachers, the new curriculum has reinforced where they were going in their practice.

Teachers are also starting to make some preliminary observations of the impact of the new curricula on their students.

> *Have seen significant improvement in el math scores, both MCA and math portion of CAT and BST's. The third grade and fifth grade MCA test scores have gone up. I can't cite you the number, but it is a really dramatic increase.*
>
> *There is enhanced reasoning. There was a section of three or four investigation questions where they just asked what do you expect, and the kids were able to just pick that up. The concepts, they seem to have.*

OVERALL SITE SUCCESSES TO DATE

- Teachers report that they like using the reform curricula.
- Teachers report that there is a move on their part to fill more of a facilitative role for the students as this encourages more group interaction and sharing among the students, and in the teachers' opinion leads to improved higher level thinking skills.
- There has been a documented improvement in elementary math test scores.
- Teachers note that students seem more engaged with math education.
- The new curricula provide a more standards-based approach to math education needed to fulfill the Minnesota graduation standards.
- Teachers feel that using this program allows the students to fulfill the graduation standards in a shorter period of time.

OVERALL CHALLENGES THAT REMAIN

- There is a continuing need for organized follow-up training and support among teachers to assure full implementation of the new curricula, including the assessment of student learning and mastery.
- Teachers need time for active communication with each other in order to re-ignite their enthusiasm, and trouble shoot.
- Parents may have needs that have not been systematically identified and addressed. There is a need to assist the teachers in developing strategies for helping the parents.
- Support staff in the school. Special education teachers, substitute teachers, and paraprofessionals need training in the new curricula in order to support its implementation in the classroom and with parents.
- There is an ongoing need to assess math curricula at the high school level as new grades are brought on board.

DISTRICT 5 PROFILE

BACKGROUND AND SETTING

District and site characteristics - The school district is located in Greater Minnesota. In 1999, the one elementary school site (K-5) adopted *Investigations*, and the middle school adopted *CMP*. Previously, the elementary school and the middle school (grades 6 & 8) had been using the Heath math curriculum and grade 7 had been using the Houghton Mifflin math curriculum. The primary issue that drove the adoption process was the recent adoption of statewide graduation standards and a statewide test of basic skills. The performance of students on the basic skills tests is thought to have put mathematics education in the district spotlight. Also, there was a desire to have the elementary and middle school math curriculum line up with the high school's *Core Plus* series math curriculum. Teachers in particular wanted to adopt new mathematics curricula that aligned better with the Minnesota graduation standards. Teachers also stated that parents of elementary students had a longstanding focus on mathematics fundamentals.

District 5

Location	Central Minnesota
Enrollment	1,354
Percent eligible for free or reduced lunch	38%
Percent with limited English proficiency	2%
Student mobility	12%
Percent enrolled in special education	9%
Percent passing Grade 8 Basic Skills Test	Reading 75% Math 67%

Source: Minnesota Department of Children, Families & Learning, 2001. Data center.

THE CURRICULUM ADOPTION PROCESS

The decision to adopt new mathematics curricula was initiated by the school district's curriculum coordinator at a point when mathematics came up in the regular curriculum review cycle. The district curriculum coordinator had a strong hand in shaping the adoption process. For example, the coordinator could accelerate or delay the curriculum cycle. The final choices of curricula at the elementary and middle school levels may be attributed to the teachers as a whole within each grade band. There was an effort to coordinate the curricula among the elementary, middle and high schools grade bands. For example, elementary school teachers met with middle school teachers, and middle school teachers met with high school teachers.

Major elements of the adoption process - The adoption process took about one year and included four major elements with some variation across the elementary and middle school sites:

1. Creation of committees at each school site. These committees were composed entirely of teachers from each grade level. The objective was to examine various mathematics curricula.

   Variation - the elementary level committee was afforded less autonomy than the middle school level committee during the examination process, whether meeting participation was required or voluntary, degree of focus on NSF-funded curricula, examination of non-NSF-funded mathematics texts. The district's geographical isolation also may have resulted in fewer visits to implementing districts.

2. Two teachers from a neighboring school teaching *Everyday Mathematics* and two teachers from a neighboring school teaching *Investigations* spent three hours presenting the two math series to all of the elementary school teachers. After the presentations each elementary teacher voted on the math series they preferred. K-4 decided on *Investigations* and grade 5 decided on *Everyday Mathematics*.

3. Visits by teachers to schools in other districts implementing various mathematics curricula were arranged to provide teachers with both an opportunity to discuss the curricula with teachers using the materials as well as to see what would be required of teachers implementing each curriculum. Only committee members visited implementing districts.

   Variation - visits varied by grade-level in terms of which curricula were observed.

4. Final selection of curricula for the elementary and middle school sites by the teachers at each of these levels. District administration accepted the adoption decisions made by each committee. No formal adoption decision was required.

   Variation - the elementary school teachers split their curriculum preferences with grades K-4 using *Investigations* and grade 5 using *Everyday Mathematics*. Consensus was reached, however, on the curriculum with a greater focus on mathematics fundamentals.

   Variation - Middle school teachers selected the curriculum based on majority decision.

Key players - The district curriculum coordinator and the elementary and secondary classroom teachers who served on the committees had the greatest influence during the adoption process. The district school board, superintendent, and principals, while supportive, did not actively influence the process. Their roles were respectively to represent the community voice, including parents, and approve the budget associated with the new curriculum adoption, delegate responsibility for the adoption process to the curriculum coordinator, and provide logistical assistance in arranging for needed substitute teachers, so teachers could visit other adoption sites. Both the superintendent and the curriculum coordinator in particular wanted to see reform that would result in improved student test scores in mathematics and that the adoption and implementation process would be carried out faithfully. Teachers from the other school districts also had some influence on the adoption process. At an elementary school site, teachers were dissuaded from using the curriculum because it was only used to supplement another curriculum. In another case, seeing other middle school teachers in action persuaded the district to implement on the basis of their students interest levels and their perceived depth of understanding,

Key issues during the adoption phase - The issues varied by school level.

Specific to the elementary school site
Issue - District administrators had concerns about how well the adoption and implementation of a new curriculum would go at the elementary level, given an earlier adoption experience that was perceived to have not gone as hoped. As a result, the elementary teachers were afforded less autonomy in the adoption process. As one elementary teacher remembers:

> *We were really never given a choice to say, 'Okay, here's a group of textbooks for you to look at. Instead they said here is Everyday Math and Investigations. Which one would you like to go with?'*

Issue - The elementary teachers were initially split in terms of their preferred curriculum; the teachers from lower grades expressed a preference for a curriculum with a greater focus on mathematics fundamentals while the upper elementary teachers preferred the more integrated mathematics curriculum. Eventually the lower elementary teachers convinced the upper elementary teachers to select a curriculum that was perceived as more "doable." According to an elementary teacher:

> *Everyday Math was difficult. There were two schools that we visited where Everyday Math was only being used a supplement for this grade level -- $100,000 and you get a supplement!*

Issue - The elementary teachers as a whole expressed a preference for a curriculum that was flexible and easily manipulated. As a result, they selected a non-spiraling curriculum that permits teachers to pick and choose lessons.

Issue - The elementary teachers felt it was critical that the district purchase all the materials recommended by the publisher and made this a condition for implementation. As a result, the district agreed to purchase all the recommended materials. A teacher recalls:

> *We said from the start, 'If you don't give us all the supplies, we are not doing this, you know.'*

Specific to the middle school site

Issue - Some of the middle school teachers of mathematics did not favor the adoption of a reform curriculum. The final choice was left to a vote of the teachers with a majority of them favoring the adoption of an integrated mathematics curriculum.

THE EARLY IMPLEMENTATION PROCESS

Teachers were expected to begin implementing the new mathematics curricula at the beginning of the 1999-2000 school year. Classroom observations conducted in spring 2001 suggest that, in general, teachers are in a transitional stage between using both traditional instructional practices and reformed practices.

Major implementation activities - Five major types of implementation activities have occurred to date, which vary by school grade level and by implementation year:

1. District purchased all necessary materials including manipulatives and calculators for elementary and secondary levels. District administrators expected full implementation to take place during the fall of 1999.

2. Five days of initial training for the principal and all teachers at the elementary level and mathematics teachers at the middle school level during the summer prior to the 1999-2000 school year. Training was provided by teacher implementers from other districts and occurred off-site at different locations for the elementary and middle school teachers. Special education teachers, educational assistants, and the middle school principal did not participate in this initial training and received no orientation to the new curriculum until after implementation had begun.

   Variation - the training sessions varied by school level in terms of the degree they focused on theory versus practice and experiential immersion in the curriculum versus planning teaching lessons for the fall.

3. Initial implementation by classroom teachers. Teachers rolled out the new curricula all at once at the beginning of the 1999-2000 school year and dropped their use of the more traditional curricula.

Variation -At the elementary level, the previous curriculum was sold before the new curriculum arrived. This had negative consequences to teachers when the new curriculum did not arrive when expected, and teachers were forced to pull together a curriculum from various sources.

4. Parent education. Parents learned about the new curricula via informational sessions after school started in the fall.

Variation - at the elementary level, teachers explained the change in mathematics curriculum at the parent conference night. At the middle school level, teachers hosted a parent open house in which they did a presentation and showed an informational video.

4. Common time for teachers to meet during the school year. The school schedule was adjusted to give teachers some common times to meet.

Variation - at the elementary level, the 1999-2000 school schedule was adjusted to afford teachers a one-hour, weekly common planning time by grade level, but this schedule was dropped in 2000-2001. At the middle school level, the mathematics teachers were not afforded any common time together during the school day in 1999-2000, but in 2000-2001 they met as a group about four times.

6. Organized consultation and support

Variation – A math trainer that was brought in along with the curriculum coordinator met with each grade level K-4 for an hour to determine how things were going and to answer any questions. Grade 5 did not meet with the trainer because they did not feel that they had any questions. The trainer also met with the special education teachers and encouraged them to get training. In April, two math teacher trainers were brought in. One taught grade 3 and met with the K-3 teachers and one taught grade 5 and met with grade 4 and 5 teachers. The trainers answered questions and showed teachers different ways to present the information. Each session lasted about 4 hours.

During the 1999-2000 school year, middle school teachers participated in two two-hour sessions during the winter and spring where teachers from other districts who had more experience with the reform curricula came to troubleshoot issues and answer implementation questions.

Key players - The teachers remain the chief implementers of the reform curricula with limited assistance from the district administrators, principals, experienced teachers from other districts implementing these curricula, or consultants from the Twin Cities metropolitan area.

Major implementation issues - Both common and unique issues have emerged at the elementary and middle school levels. In some instances, the issue has yet to be addressed.

For all grades
Issue - A number of key staff including paraprofessionals, principals, and special education staff have not been able to effectively support the implementation of the new curricula because of their lack of involvement in the initial training sessions.

Variation - At the middle school level, two of the special education teachers were subsequently sent to a five-day training session during the 2000-2001 school year.

Issue - While parents have not actively complained about the reform curricula, teachers and principals report that parents of both elementary and middle schools children have indicated that they feel they do not know how to help their children with mathematics at home or that they do not understand how the new curricula will help their children in understanding mathematics in terms of mechanics and concepts. The school staffs recognize the need to assist parents but have yet to implement any systematic strategies.

At the elementary level

Issue - Prior to rolling out the new curriculum, the district sold the previous mathematics curriculum. As a result, the elementary teachers experienced some stress as they quickly pulled together new curriculum materials from multiple sources.

Issue - Individual teachers, for different reasons, are experiencing difficulty in implementing the new curricula. The district has yet to establish any systematic process to assure full implementation of the curricula by all the teachers.

Issue - Teachers perceive that some of their students, particularly older elementary students, are struggling with the rapid implementation of the new mathematics curriculum. Teachers commented that in retrospect, it might have been smoother for students had they phased in the new curriculum by grade level - first, second, third grades in year one, fourth grade in year two, and fifth grade in year three.

Issue - As a result of low-test scores among elementary children (third and fifth grades), the curriculum coordinator hired a consultant to evaluate student test scores and provide recommendations to the elementary teachers to improve test scores at the beginning of the 2000-2001 school year.

- As a result of that consultation, all elementary teachers have begun supplementing the reform curriculum with computational skill building activities. Some teachers report frustration that the district has not allowed enough time for the implementation to take effect.

- Some teachers are cringing at the expected adverse parental response to the curriculum supplementation. The previous year, teachers had told parents that no supplementing would be necessary for the children.

Issue - The elementary teachers were not afforded any common planning time by grade level during the 2000-01 school year to allow them to continue building their collective implementation capacity. While it is unclear why the planning time was discontinued, teachers have petitioned the principal for the reinstatement of the common planning period.

At the middle school site

Issue – All grade 7 students are given an algebra aptitude test. The scores on this test along with teacher recommendation determine if the student going into grade 8 will be in an algebra or standards-based mathematics sequence.

Issue - At the present time, policy is not set regarding which mathematics path students should follow through high school. The reform curriculum has been implemented in the high school, but some 20 percent of the students still follow the traditional curriculum.

IMPACT ON TEACHER ATTITUDES AND PRACTICES

After two years of implementation, it is evident that teachers struggle with the change in work habits and instructional practices and the amount of work involved in making the change. Teachers commented:

> *We had to learn how the books worked and fit together. We also had to learn the order of the books and where the standards are placed in the books. It was a lot of reading. I carried the teacher's guide with me practically everywhere I went last year. It was a lot of preparation.*

> *The big concern was the amount of work it was going to take. It was very student driven and not teacher driven so you had to take time to prepare. I mean you can't get out the overhead and say okay, here is the worksheet that we have to do. You are going to find your own strategy, here and there is no wrong answer until you find the find the right answer. It is a whole new way of teaching, and it is uncomfortable for anyone who has done it the other way for 20 years.*
>
> *Some teachers remain resistant.*

Also evident is the magnitude of deep change that teachers must deal with in terms of how they learned mathematics, how they learned to teach it, and how they have practiced:

> *It was a big change. I had a concern that some of our staff members would try to buck it or not accept it. Personally speaking, you were worried that you were going to try to buck it a little bit. I was a good traditional math student. I could memorize my facts and so that is the way I liked to teach it. I also knew my algorithms.*
>
> *The whole process was a leap of faith because we went totally against what we had been doing for years.*
>
> *They talk about paradigm shifts and I think this is one for me. This is giving the material to the kids and the kids discover how to arrive at their solutions to a problem.*
>
> *I used to teach* [out of a book] *with a lot of paper and pencil.*
>
> *I'm really cringing about* [teaching] *computation. Last year I would say to parents, 'Don't worry about his. They will get it.' One year later, I'm going to be saying, 'I'm teaching computation* [supplemental to the curriculum]*.' Now those parents who have children in the fifth grade this year are going to say that the teacher last year never taught them computation.*

For some teachers, however, the new curriculum has reinforced where they were going in their practice. Others are beginning to identify how their practices are changing. For example, teachers commented:

> *I felt like the curriculum finally gave me the tools I had been testing out on my own.*
>
> *Patience is the key to the curriculum. I am so tempted to jump in and say: 'Math will go much faster this period if you . . .'*
>
> *Teachers are becoming better questioners.*

Teachers also are starting to make some preliminary observations of the impact of the new curricula on their students:

> *Math is more interesting for the kids. I think the students like this type of math just because it is very social. They're getting to be with partner and it takes a lot of the stress off of them.*
>
> *The students see it is less work even though I think they're thinking better and learning as much.*
>
> *Some students would not participate.*

The students who excel in math continue to do well. The students who do poorly still do poorly. Some of them get it and some of them are more lost than they would have been before.

Advanced students have no better grasp of math concepts than the standard students. There are those students who are good at following algorithms and getting the right answer. I believe there are still students who don't have any better, deeper understanding of concepts than the students in the other [reform] *classes because they ask me similar questions.*

OVERALL SITE SUCCESSES TO DATE

- Teachers generally report that they like using the reform curricula
- Teachers report that students appear to be learning how to work cooperatively
- Teachers note that the attitudes of students toward mathematics have been positively influenced -- they are planning to enroll in four years of mathematics as they enter high school

OVERALL CHALLENGES THAT REMAIN

- Continued ambivalence both among the teachers and within the district administration whether or not to continue with the curriculum adoption plan.
- There is a continuing need for organized follow-up training and support among teachers to assure full implementation of the new curricula, including the assessment of student learning and mastery.
- Support staff - e.g., paraprofessionals, principals, and special education teachers - needs training regarding the new curricula in order to support its implementation in the classroom and with parents.
- Parents may have needs that have not been systematically identified and addressed.
- The implementation of a new curriculum is a complex change to introduce into a school district and school site. The change process must address the natural learning anxiety among teachers, parents, and students. These players may all need better lists of the options and resources from which they may draw in order to develop their knowledge and competencies. The one option that teachers have favored is a common planning time during the school day. This and other options needs to be made available to teachers and parents to support their learning.

DISTRICT 6 PROFILE

BACKGROUND AND SETTING

District and site characteristics - The district is one of the largest urban districts in the state. It contains one of the most racially and economically diverse student populations. Seventy-four percent are of the children enrolled in the district are students of color. The largest group of students of color is African American followed by growing Hmong and Hispanic populations. Schools in the district are also home to a very fast-growing population of students who have limited English proficiency. It is estimated that within five years, nearly one third of the children will have a first language other than English. Sixty-six percent of the students receive free or reduced lunch – a common indicator of social and economic status.

District 6	
Location	Urban
Enrollment	48,834
Percent eligible for free or reduced lunch	66%
Percent with limited English proficiency	22%
Student mobility	33%
Percent enrolled in special education	13%
Percent passing Grade 8 Basic Skills Test	Reading 51% Math 42%

Source: Minnesota Department of Children, Families & Learning, 2001. Data Center.

GENERAL CONDITIONS AT THE TIME OF THE ADOPTION

At the time of the adoption, teachers and district administrators were looking at the curriculum to fulfill three primary goals. The first goal was to move towards simplifying the course work children need to take and to help all students succeed in mathematics. This was to be accomplished through the creation of more interdisciplinary courses particularly between science and mathematics. The second goal was to implement a curriculum that would aid in knowledge construction and promote language skills. The final goal was to implement a curriculum that would support changes in teacher practice across all grades. Previously the elementary schools used a traditional program curriculum (Addison-Wesley).

THE CURRICULUM ADOPTION PROCESS

The district was one of the earliest to adopt a standards-based mathematic curricula, which occurred in 1996. The decision to adopt the new mathematic curriculum was initiated by district administration. There had not been an adoption cycle in place in the district in any content area for some time. The adoption was compulsory for all grade levels. Middle and high school teachers were quite familiar with the National Council of Teachers of Mathematics (NCTM) standards and attempted to select curricula that conformed to these and to district content standards. Teachers in the high school had also taught a prepublication version of *IMP*.

Major elements of the adoption process - The adoption process lasted for one year and had four major elements. After the decision was made at the district level to begin a mathematics adoption, the process shifted to a predominantly teacher driven process.

1. Elementary schools formed a curriculum committee. The curriculum coordinator asked two elementary teachers to head up the committee. The committee was comprised of 30 teachers, who were representative of the various grade levels, ethnic mix, and various areas of the city. A parent and a principal also served on the committee.

Variation - At the secondary level department chairs met in a middle school group and a high school group. The committees would be brought together for two days every other week. Teachers asked textbook companies to send samples.

2. Committee received training and used an adoption process developed by the National Council of Supervisors of Mathematics (NCSM) that laid out how to adopt a standards-based program.

3. Committee narrowed the field of curriculum to four curricula, Quest 2000, Everyday Math, Windows on Math, Houghton-Mifflin. More traditional curricula were eliminated.

4. Decision process - The elementary process involved a lot of work prior to the adoption decision. This process was specifically designed to result in the selection of a single curriculum. Elementary teachers wanted to go with a single adoption. Everyday Math was selected based on its ability to aligned with district standards. Individual buildings are required to and responsible for ordering the materials.

Variation - At both high school and middle school, the NCSM process was not implemented, and the committees ended up with several curriculum choices. Since some teachers in middle and high schools had piloted *CMP* and *IMP*, those were considered to be on the table as part of the adoption decision. Teachers were allowed to select one other more traditional textbook to use. In 2001, all schools in the district have both *IMP* and a traditional pathway at the high school level.

> *Secondary teachers were not able to agree upon a single curriculum because the teachers were in different places and still are. The district has a very traditional group and a group that is much more reform-oriented.*

Key players – The curriculum coordinator was responsible for organizing the process, developing a set of guidelines for evaluating textbooks and seeing to it that the adoption process was carried out. Other administrative staff played smaller roles in the adoption process. The teachers serving on the committees (30 elementary teachers in one group, and a core group of department heads and department chairs at each secondary level) strongly influenced the adoption decision. Principals played minor supporting roles. District parents played only a token role in the adoption process. Players outside the district, such as teachers from other districts, textbook representatives, and CFL staff, similarly had little influence on the adoption process.

KEY ISSUES DURING THE ADOPTION PHASE

While the adoption occurred six years ago, some issues surfaced with regard to the adoption phase.

For all grades

- The adoption occurred prior to the acceptance of the Minnesota graduation standards, therefore those standards had no effect on the decision.

For the elementary schools site

- Elementary teachers wanted to a single adoption.

- Elementary teachers looked at Investigations, but the third and fourth grades were not available, thus Investigations was dropped from consideration.

  I was in the third and fourth grade group, and we liked Investigations best of all, but we couldn't buy it because they didn't have all of K-6. That probably would have been our program had other sections been ready.

For the high schools site

- A few high school teachers definitively shaped the adoption decision. In particular, three teachers researched texts, convinced their principals to visit IMP authors, received training, piloted a pre-publication version of IMP, and advocated for the selection of IMP. Other teachers were interest in aligning with NCTM standards.

  At the adoption time, the district wanted to teach algebra to everybody. But it just didn't work. So we tried to go to two-year algebra courses, and that didn't work. So we just said, 'Help, we have to look at something else.' So we came back and decided that what we really wanted to do was IMP. We got some Eisenhower money to put on a one-week workshop that summer for other teachers.

- Secondary teachers wanted to have choices, which resulted in the selection of two curricula, one standards-based curriculum (IMP) and one a traditional book (text varies by school site). The district elected to maintain a two-track system such that teachers were permitted to choose between a traditional curriculum and a standards-based curriculum.

  There's some tension around the dual track; teachers are getting both messages.

- At the time of the adoption decision, neither Arise nor Core Plus were ready. Teachers felt IMP was a quality program and went with it.

  IMP was one of the only programs back then. We didn't have a chance to look at Core Plus or the other curricula that are out now.

THE EARLY IMPLEMENTATION PROCESS

The elementary teachers were expected to begin implementation in fall 1997. The middle and high school teachers were also supposed to begin implementation in that year. Implementation in the elementary middle and high schools was rolled out in one year.

Major implementation activities – Key elements of the implementation activities included the following steps.

1. Initial training at the elementary level consisted of one day of training that was grade level specific. At the time, all teachers received the initial training prior to teaching the curriculum. If it was not taken as an elective in the summer, it was taken as a requirement in the early fall. An unknown number of educational assistants and paraprofessionals were involved in the training.

   Variation –at the high school level, initially, teachers used grant money from a regional dissemination award through San Francisco State University to train teachers. When those funds were exhausted, monies from the MASP[2] (Minneapolis and St. Paul Merging to Achieve Standards Performance) grants were used. The district has tried to support high school teachers in building their pedagogical understanding through summer workshops. High school and middle school teachers received two weeks of summer training prior to teaching. First year teachers also received mentors.

2. Follow-up training – Elementary teachers also received regular in service training, perhaps five times spread throughout the year. The district as well as the school organized and conducted these sessions. Sessions varied from 45 minutes to two hours and focused on actually working through lessons and seeing the curriculum through the students' eyes. Staff was required to attend these sessions.

   > *There were several. One was on probability. We did one that focused on the games and the explorations, and some others as well.*

   Variation – high school teachers received about five days spread out through the year. Much of the time was spent directly applying the materials to the classroom environment.

   > *The thrust of those was most of the time was spent in working through student activities. There was also a lot of discussion as to how the lesson plays out in your classroom, instructional strategies, assessment, and how to help kids work in groups. You are not ready to talk about this until you have struggled with it. Each year that we would teach a new year of the curriculum we would repeat that process. With the grant that we had then, we had money to have one hour a day teamed up with another teacher. So, two teachers would be teamed up for thirty students. Somewhere in the day, you and that other teacher would also have a common planning period.*

3. *Common planning time for teachers* – Elementary teachers met one time per week in a grade level cluster meeting. Teachers reported that these meeting frequently focused on mathematics content. Teachers also wrote their professional development plans together and conducted peer discussions about their goals.

   Variation – Teachers at the high school site meet together every Wednesday morning before school; all *IMP 2* teachers meet together. These meetings were voluntary so on some occasions two teachers meet and on other occasions all four *IMP 2* teachers were present.

4. *Mentors* - the district hired mentors to work with these teachers in the classroom. In the elementary school each mentor works with 20 to 25 teachers.

5. *Additional external funds were used to extend professional development opportunities* – For example, a grant for after school tutoring was used to enrich teachers training in *Everyday Math*. The elementary school has also purchased a complete set of videos from the publishing company just for teachers, and each grade level has their own specific set.

6. *Other district support* – Elementary schools have the infrastructure to support a math liaison, which is used to communicate training and district goals to all teachers at the school site. The district also has $30,000 a year that is set aside for professional development opportunities. It exists in two formats.

   > *Every teacher has to have a professional development plan. What we have done is created self-selected or self-identified study cohorts. They may be 'Math across the curriculum' or 'parent involvement' or 'a National Board certification cohort.' We give each of these cohorts a chunk of money—depending on the size of the cohort, anywhere from $500 to $1,000. And that's theirs to use. They decide how it will be used. And then we also set aside about another $25,000 that is general staff development money that teachers apply to a committee to get.*

Variation - The district also sets aside three to five days during the year in which teachers work together and plan approaching new units. Other staff development days are available in the district to address particular concerns of CMP and IMP teachers.

Variation - The district admits it has not done as adequate a job with teachers using the traditional materials.

Key players – The district is in its sixth year of formal implementation. Several teachers within the district and across all grade levels have piloted or used some standards based curriculum in their teaching for much longer. While district administration played an active role at the onset of the adoption, implementation has been mostly left to teachers. In part this reflects the tradition of strong teacher autonomy in the district.

Major implementation issues – Both common and unique issues have emerged at the elementary and high school levels. In some instances these issue remain unresolved. Common issues to date include:

For all grades
Issue - The district applies for and is awarded grants in a variety of areas, which help fund teacher professional development, applied research, and curriculum development.

> *We haven't done a good job of training at the elementary level because we haven't had the money, and we have so many elementary teachers. So the grant, which has a real elementary math focus, will hopefully help.*

Still in some instances, teachers are too busy to receive benefits from the funds that are available.

> *But what's interesting was that the targeted schools, very few of them applied. Which kind of shows you that things are either so bad or so stressed out, that they don't have it together enough to put something together that they need.*

Issue - The district's size limits the amount of district oversight, supervision, and assistance.

> *In this district we have over six dozen schools and there are really just two of us, there is no way we can check out quality so we've developed these implementation checklists*

Issue - There are teacher promoters, at all grade levels, who have pushed for change in mathematics curriculum and instruction.

> *I heard about EM and started reading about it before we actually implemented it and then got involved at the district level right away.*

Issue - The priorities of district administration and the teachers' union are evidently at odds occasionally.

> *So again, the amount of training varies, and we haven't been able to do new teachers as well as we should. We've tried to ask for more time, but the union has all these other things. The union gets teachers for two days and they give the district an hour.*

Issue – Pacing, spiraling and assessments were fundamental and interrelating concerns, particularly of elementary teachers.

> *How can you assess and grade? That's one of the hardest things to learn because now you are doing a more holistic reading.*
>
> *This is what I was taught: You keep plugging away at something until the kids have mastered it and then you go onto something new. And that was one of the hard things for me when I was first time teaching this curriculum was the whole spiraling concept. I found that really hard at the beginning. And that was because I wanted the kids to master it. I had to learn to trust the spiral. Trust it. They're not going to get it the first time. You just have to keep hitting them with it– they'll get it. Just trust that.*

Specific to the elementary school site
Issue – Elementary schools were forced to adopt *Everyday Math*, which resulted in some frustration, particularly by teachers in the upper elementary grades.

Issue – At the elementary school site, teachers have ability grouped the students to address student needs.

> *The goal was meeting the needs of all the different students. In fourth grade, it's a little easier because we've broken the students up. It was hard to address that issue because Everyday Math is targeted towards your so-called average students. And it was hard to hit the bottom and the top.*

Issue – Most teachers at the elementary site use *Everyday Math*.

> *Now everybody has jumped on board. It has taken a couple of years. But, I would say, the majority of our building is on board.*

Issue - Teachers report that some teachers may have retired to avoid making the changeover to the new curriculum.

> *We've had a few teachers retire, and I feel that maybe some of the ones that retired were the ones that hadn't bought into it quite as much.*

Issue – Surveys, administered by the district, show how little time some of elementary teachers in the district have spent each day teaching mathematics.

> *We really want 90 minutes. But we did a survey and we found that most teachers were spending at least 45 minutes or 50 minutes on Math.*

Issue – Hiring large numbers of new elementary and middle school teachers in the district has resulted in many of them not receiving the initial curriculum training.

> *We have many, many, very new teachers, so we have a lot of teachers who never even got that one or two hours because they weren't here. I estimate about half our teachers haven't even had that training. They received about an hour of math at new teacher meetings. About an hour! And so they're either learning from their peers or they're fumbling around.*
>
> *Everyday Math, it's a little more teacher-directed than the Investigations. And teachers that aren't as strong in mathematics can use it a little easier.*

Issue – Schools use parent and community volunteers to help out in the classrooms.

> *I have one set of parents that have been volunteering in my room for five years. Even though I haven't had their kids for years.*

Issue – Parents are unfamiliar with the materials. So the school developed packets to try to advance parent understanding.

Issue – The new curriculum has proven to be a language barrier for parents with children with limited English proficiency.

Issue - Elementary teachers meet with parents during a math night at PTA. At that meeting teachers introduced the curriculum, showed a video, demonstrated how manipulatives are used and so forth.

Specific to the high school site

Issue – Twenty percent of high school students continue with the traditional mathematics curriculum. This has lessened some parent and teacher resistance but slowed full implementation of *IMP*. Administrators are reluctant to force teachers to teach in any particular way.

> *So, in a sense, we've avoided the problem by having both tracks. But on the other hand, we haven't gotten that critical mass. We're about half and half.*

Issue – Teachers at the high school level are taking seriously the Minnesota graduation standards.

> *As a result of that meeting, is we looked at the state performance packages, and we said, 'These are the standards that our students are supposed to be meeting; and technically, if we do this particular problem of the week, we can say we've met the standard.' But none of us thought we met the spirit of the standard. So, together, we completely re-wrote it into a one week unit.*

Issue – Even seasoned teachers continue to lapse into more traditional instructional practices as needed.

> *Even as much, as long as I've been doing this, I still find myself, on those days when I'm tired or the kids are a little bit more unruly. I mean, you revert back right away because that works. You quiet everybody down that way and you feel more comfortable.*

Issue – Some of the external funds (MASP^2) were intended for first year users only, so the curriculum coordinator freed up additional funds to compensate mentors for second, third, and fourth year users, because they needed continued support.

Issue – Teachers found that the chapter reviews were too difficult and were forced to redo some of them. They ended up re-writing all of the assessments.

IMPACT ON TEACHER ATTITUDES AND INSTRUCTIONAL PRACTICES

The curriculum coordinator relates that, teachers who have approached the curriculum with an open mind have been successful and have not complained about the curriculum.

> *And I haven't seen one school where there's been complaints, where they've really given it the shot they're supposed to and really tried and the kids didn't learn. I haven't seen one of those. It's all been, 'Well, we didn't like it from the start.'*

The standards based mathematics curriculum has been a big change for new teachers in particular.

> *When I looked at the fourth grade curriculum in math, I thought, 'Omigosh, how am I going to do this?' I felt uncomfortable because I didn't know about the different types of algorithms. So it was more of what I didn't know and what I felt I had to learn it so I could teach it to the kids.*

The curriculum helped foster teachers content capacities and heightened their interest in mathematics.

> *I think that, the IMP curriculum, because it has the probability and statistics in it, has deepened our own teachers' content capabilities. I think, from a professional point of view, that's been a real plus for them. Some of them have said that they were really getting tired of teaching—it wasn't any fun anymore, and this is fun.*

> *This is the eighth year that I have taught IMP one. There is something new that I can learn every time that I teach the class or a lesson.*

Teachers struggle with how they learn and how best to teach.

> *Actually, I looked at some of the games and they seemed fun. And I tried them out before I did it with the kids. I tried them out with my nieces and nephews at home saw their reaction to them.*

> *The first year of implementation was very difficult because it's such a different concept. People weren't used to it. It was a real struggle.*

> *I guess I sometimes have this really negative attitude towards math, especially because I've always struggled in math. And I didn't want to pass that on to the kids. So when I get up in front and am presenting a lesson to the kids...What I struggle with is, I try not to let those insecurities show to the kids. I always tell them that when I was their age, I had a really hard time doing what they're doing, so I know exactly what they're going through. We'll struggle through this together.*

> *I am beginning to learn how much structure that I need to give to an activity. If I have a group that can do more then I back off on some of it. The next hour I may need to provide more structure. It is a long process of building up that student confidence. I can help them look at something that they've never seen before. I can help them to attempt it. I can show them how talk to others.*

Teachers are pushing children to learn together on their own instead of from the teacher alone.

> *The problem involves six equations and six variables. She said, 'I set up the problem for them. I am being mean. I am not going to help them. They are working on their own.'*

> *I want to have the student more actively engaged in problem solving. People always say the students might do it wrong! Then I say, I know where we are going. I know where we are starting from, and there are three or four ways to get there. I will post the problem. I get them started and then I validate all the ways that they got there. Joey got there this way...Susie used this...*

Teachers see students who are positively motivated.

Many parents remain unmoved by the new curriculum, preferring the traditional approaches.

> *Parents, especially in the southwest part of the city, the more affluent part of the city, want traditional math for their children. They want their children to get high SAT's and get to college, the best colleges.*

OVERALL SITE SUCCESSES TO DATE

- Documented improvement on student achievement tests.

  A paired comparison study, a couple of years into the implementation of our IMP showed that for the students who were less mathematically prepared, the IMP curriculum really did seem to have a positive impact on their ACT.

- The implementation of the curriculum has been in place for sufficient time that sixth grade students have had Everyday Math throughout their elementary grades.

- CMP has become the norm in the middle schools across the district.

- IMP allows students to reach the standards more quickly than the traditional curriculum.

- Teachers believe that the standards based mathematics curriculum is accessible to a greater number of students and a more diverse range of abilities in mathematics.

- More teachers appear to be collaborating and more open to different approaches to solving problems.

- Teachers in the elementary grades are seeing that the spiraling concept is paying off.

  In years past, I was teaching first grade, and I had a lot of these students in first grade. And now I see in fourth grade that spiraling does work. Because stuff that I had a hard time trying to pound into them in first grade, in fourth grade, they got it!

- The standards based curriculum is believed to reinforce language acquisition for some LEP students.

- Teachers indicate that students are taking four years of mathematics in the high school.

  When we first started teaching IMP, 65 percent of our seniors were taking a math class. Yeah. And right now, we're up in the 90%

OVERALL CHALLENGES THAT REMAIN

- In a district so large it is difficult to coordinate and disseminate professional development to all teachers.

- Revised NCTM standards have raised questions in the minds of some teachers and have further fueled the debate between reform and traditional programs.

- Children with limited English proficiency have a difficult time with the largely language centered mathematics curriculum.

- Schools of such a large district must be responsive to political pressures exerted by the school board, superintendent, and other pressures from beyond the classroom.

  One board member felt that the Everyday Math program, in particular, probably CMP, too, didn't teach enough of rote learning and wanted these programs to be supplemented. She liked the program but wanted to supplement it.

DISTRICT 7 PROFILE

BACKGROUND AND SETTING

District and site characteristics - The district is a larger suburban district with both high and low-income households. Key informants in the district describe the student population as stable. Recent successful referenda have provided funding to build many new facilities as well as address deferred maintenance. The district also has an active parent constituency and is home to an educational foundation developed and run by volunteers (predominantly parents) that recognizes and provides financial awards for innovative teaching ideas and high student achievement.

B. Math curriculum prior to NSF-curriculum adoption

District 7	
Location	Suburban
Enrollment	11,412
Percent eligible for free or reduced lunch	16%
Percent with limited English proficiency	2%
Student mobility	18%
Percent enrolled in special education	10%
Percent passing Grade 8 Basic Skills Test	Reading 78% Math 69%

Source: Minnesota Department of Children, Families & Learning, 2001. Data Center.

THE CURRICULUM ADOPTION PROCESS

The 1997 decision to adopt new mathematics curricula was triggered by the curriculum cycle, and coincided with the Minnesota graduation standards. The staff considered the graduation standards, while not yet officially adopted, as inevitable. As a result, the district decided to proceed as if it were going to take place. Fortuitously the curriculum adoption cycle for mathematics was delayed for one year to allow for completion of the previous adoption.*

Also important in the adoption process was the curriculum director's insistence that all available curricula, traditional and standards-based, be considered in the middle school portion of this process (Due to lack of consensus by middle school teachers at the beginning of this process). He would not allow materials to be removed from consideration out of hand.

> *I do have huge faith in the collective wisdom good teachers and solid parents, working together. They'll make good decisions. So we had these reviews, and we did. We reviewed everything on the market in middle school mathematics. Everything!*

Major Elements of the Adoption Process –The adoption process contained two phases: (1) the articulation of goals by the teaching committee followed by, (2) the adoption of a core set of materials to reach the articulated goals.

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* That delay was important in that the curriculum selected by the high school was not available until that year.

Part 1. Articulation of goals, October 1997

1. Survey to assess parent needs and desires
2. Curriculum committee articulates subject goals, which involves a year of self study followed by two or three weeks in the summer writing curriculum goals
3. Curriculum committee looks at curricula the fall after the curriculum goals have been written. 1998 was the year to study materials.

Part 2. Adoption of core set of materials, 1998 materials study year

1. After curriculum goals have been approved by the joint parent-teacher body (Citizen's Advisory Committee on Curriculum)
2. Look at a wide range of curricular options
3. Selection.

Teachers in the district are compensated for additional time they put in during the adoption process.

Key players - The curriculum director is a well-respected, consensus oriented leader in the district. The director, middle, and high school teachers played substantive and influential roles in the adoption process. Elementary school teachers played moderate roles in the adoption process: participating through committee work, meeting to discuss concerns about the previous curricula and identifying objectives of a new curriculum. Principals in some cases were highly supportive, while in other cases actually became obstacles to adopting the new curricula. The superintendent, publisher representatives and teachers from other districts played supporting roles in the adoption process but had little direct influence upon the process. Efforts by Department of Children, Families, and Learning staff in training and parent information sessions were considered important and helpful.

GENERAL CONDITIONS DURING THE ADOPTION PHASE

- In the district, administrators acknowledged the challenge of keeping up with the shifting demands and emphases of the legislature and Department of Children, Families, and Learning regarding the graduation standards and the Profile of Learning.

- In the district there was a collective recognition that the subject of mathematics needed to be changed if all students were to meet those standards put forth by the state. It was very important to district staff that all children, not just the most able, be successful in meeting the standards. Middle and high school teachers also had a concern that in previous years too many students were placed in accelerated mathematics courses. As a result, teachers feared that some students had lost an appreciation for mathematics. Middle and high school teachers also agreed to accelerate no more than ten percent of the students in mathematics. Teachers hoped that the new curriculum would engage students more profoundly in mathematics.

- District parents were involved in a wide range of activities and played a stronger role in the adoption than parents in most other districts. For example, parents were formally integrated into the curriculum adoption process. Parents volunteered to serve as curriculum committee members for a three-year period.* This process had been in place for as long as the curriculum director had been on the job, which was about seven years. Parents were also key instigators in the development of an education foundation for the district.

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* The three year commitment ensures that the parent committee member is interested in curriculum broadly and is not interested in a pet subject or project.

KEY ISSUES DURING THE ADOPTION PHASE

There were some issues common that arose across all schools and grade levels, including:

- A feeling that the graduation standards in effect pushed the district into a standards-based curriculum adoption. While it was less certain at the time which curriculum would be selected it was almost certain that the curriculum would be an integrated curriculum.

  > *Teachers came to the conclusion that in order to meet Minnesota graduation standards they could not use the traditional programs.*

- The district has been struggling to address district diversity, which is reflected in social economic diversity and also increasing racial diversity to a lesser extent.

- At all levels, teachers were willing to jump into the curriculum sooner than anticipated.

  > *There were two fourth and two fifth grade teachers in the district that jumped ahead. They implemented because they wanted to one year ahead of everyone else at the fourth and the fifth grade level. When it came to year two and time to implement grades three, four and five. We had two experienced teachers at grade four and two experienced teachers at grade five who had been down the pike and had worked with kids.*

Specific to the elementary site

- A heavy influx of new elementary teachers, allowed for an easier transition to the reform curriculum according to the principal. The principal has hired nearly half of the teachers in the elementary school over the last five years.

Specific to the middle school site

- Key teacher initiators of the reform curriculum helped advance the switch to the reform curriculum and there was a high level of general support from all teachers. The reform curriculum received almost unanimous support. Two or three abstentions originated from teachers preparing to retire.

- There were several early and longtime advocates at the secondary level. These teachers were encouraged and permitted to pilot curricula and pursue professional development. These same teachers were also very familiar with the national mathematics standards (NCTM) through discussions that had occurred at the national level for the last decade. Secondary teachers were a seasoned team. They received a lot of training together and knew each other well.

  > *I was excited about the promise that it seemed to hold which was getting past "if you listen to me, do as I do, do it the way I do it, don't miss a step because otherwise you'll do it wrong.' That kind of blatant just memorize, to creating a sense of understanding about mathematics. I wanted to get to that point. So about ten years ago we looked for an integrated curriculum. We really did.*

- Until recently the district has had a weak professional development program budget. This has changed. In the case of the mathematics adoption, there was a significant increase in the amount of resources put into staff development over a longer period of time, in part because it was considered a huge shift. The two-year implementation schedule was in part to absorb the cost over two years and in part to make more funds available.

- External funding from MASP[2] (Minneapolis and St. Paul Merging to Achieve Standards Performance) was leveraged to provide additional professional development funds, that is, the training offered was not the driving force of the decision but provided additional incentive. It was one important consideration in the decision to us a reform based curriculum at the secondary level.

THE EARLY IMPLEMENTATION PROCESS

Standard implementation plans for the district calls for a full roll-out of the curriculum. For this adoption the roll-out was allowed to last two years both in acknowledgement of the dramatic change and to spread the costs of the adoption over two years instead of one. The (K-2) elementary school teachers were expected to begin implementing the new curriculum in fall 1998. The following fall, teachers in grades three through five were to begin implementing. Middle school teachers began implementing in fall, 1998.

Major Implementation activities - Four major types of implementation activities have occurred, specifically for this adoption,* to date, that varies by school grade level and by implementation year. Key components included initial preservice training, follow-up sessions, planning time among teachers, and mentorships.

1. *Initial training.* All teachers received initial training that ranged from one day for elementary teachers to two weeks for middle and high school teachers. Elementary teachers stated that they liked attending sessions which were led by teachers from their specific grade level and who had been using the curriculum. Secondary teachers received 80 hours of training the first summer prior to teaching the curriculum. Teachers reported varying degrees of appreciation for the trainings, citing the time commitment and differences in learning styles as the barriers to unqualified appreciation.

   I think that having the opportunity to formalize your education with all of the training, probably, if nothing else, I know it had some benefits because we had conversations after the trainings. But what it really did was legitimize the angst that, yes, it is hard and you are struggling and this is tough work that you are doing and it's not an easy transformation. If nothing else it gave them the assurance that all of the insecurities that they were feeling were okay.

2. *Follow-up training.* Elementary teachers also received follow-up training, which varied in structure and content. Elementary school teachers attended short meetings throughout the year (perhaps 20 times) where they focused more on problem solving and questions that arose during implementation and less on instruction. Sessions included teachers from other districts and the publisher representative. The principal has made professional development funds available to teachers and provided a listing of professional development opportunities on a weekly basis. Secondary teachers received 50 hours of follow-up training throughout the first year. During the second summer after implementation began (1999), secondary teachers had the option of attending an additional 40 hours of training.

3. *Planning sessions.* The elementary school principal has established topical study groups, which meet semimonthly. Secondary teacher planning opportunities varied by site. For example, one department met every single lunch period the first semester of the initial implementation year. Others schools met on an ad hoc basis or not at all.

4. *Mentoring.* Elementary teachers received no formal mentoring in the curriculum. Secondary teachers had a mentor for each of the first two years of implementation.

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* Implementation steps identified do not include curriculum piloting, which occurred with individual teachers, but is not part of the district process.

IMPLEMENTATION PROCESS

Key players - The district is in its fourth year of the formal implementation. While the curriculum director works closely with schools, teachers were the main implementers of the new math curriculum. Three particular strengths stand out as supports to teachers who are implementing the curriculum in this district. (1) The district administration, including the curriculum director, is fully behind the implementation and the philosophy of the graduations standards and the Profile of Learning; (2) the experience and passion for mathematics is strongly evident in the secondary teaching staff; and, (3) parents are aware of the adoption through participation in the process and seem to take an active role in the district.

Major implementation issues - Both common and unique issues have emerged at the elementary school and high school levels. Common issues and actions to date include:

Issue - Teachers report parent concern for traditionally high achieving students for all grade levels.

> *I think early on one of the hottest groups were the high potential parents. They were really concerned about the curriculum change. Because I remember going in and the curriculum coordinator asking me if would go speak to a group of high potential parents at one of the elementary schools. The parents there wanted to ask another parent questions about the curriculum.*

Issue - Teachers report that the implementation was a big shift for them and for their students.

> *The hardest thing is changing teachers' way of teaching, to go from the lecturer to the facilitator. That is by far the hardest thing.*
>
> *I think probably the hardest thing I had to learn was to get used to students choosing different systems to work with. It wasn't any one given system. It was a multiple array of systems that they could use. I always enjoy when a student comes up and debates an answer. I have always enjoyed that. I think this program lends itself more to that, they will say, 'But my answer is correct, and the way I did it was this, this, this & this.' And getting used to students saying, 'OK, there are other ways to do this; but you can do it this way.'*

Specific to the elementary site
Issue - Teachers report that they continue to supplement the material to provide more skill practice and enrichment

> *I still need the students to know the basic facts. The other thing that I really stress—I go outside of the program to pull additional materials on this—is the ability to figure out how to solve problems. There's a whole logical sequence on problem solving. And so, I still use like Problem Solver. I use Continental Math to get multiple steps, to just increase their ability to think through problems. Then, once they do that, they say, 'Oh, that is easy!'*

Issue - Teachers are also starting to make some preliminary observations of the impact of the new curricula on their students:

> *Well, I think the first year when students were in the program (especially our older children, like our fourth and fifth grade), I really think that was a challenge for them. Because as you teach them algorithms and other strategies to do regular multiplication that they've learned in maybe*

third grade; and all of a sudden, there's a different way to do it—I think some of the children who are 'adult pleasers' who are trying to do them all that way, and they didn't necessarily hear the

teacher or the parent saying, 'You're happy doing it this way. You're choosing your way.' And I think, as the children go through, they're going to choose the way they do their problems. And then it won't be so frustrating.

Issue - Elementary teachers indicate the shift required when thinking about taking ongoing assessments, pacing, and student mastery.

> *It's a change in what all of us have been trained. To move on without a child having mastery. You know, before, as a teacher, you'd move on, maybe one child, maybe your special ed child, didn't have mastery. But now it's, you know, a bit, and then you move on; and then it's a bit, and it'll come back.*

Issue - Elementary teachers report that parents remain skeptical of the standards-based mathematics curriculum, but the teachers are seeking out ways to help the parents along.

> *But we just had a meeting this morning with a second grade parent about the drill and practice and how she was kind of frustrated because there wasn't a lot of activity drill coming home; and to explain to her that the child is drilling when they're in the classroom, and their journals...The home links aren't necessarily a 'drill,' you know: 50 questions. But, because we've all been trained that way, she kind of wants that. So we're going to try to help a little bit by devising some things so that she feels comfortable with helping her child.*

Specific to the middle school site
Issue - Even the most talented teachers are having difficulty getting through the curriculum at the rate the publisher suggests.

> *One of the district's best teachers- -and I mean, I would stack her up against any teacher anywhere—told me with respect to that, said last year's students were an extraordinarily strong group. The teacher said, that 'even thought it is my second year I probably am not going to get that much farther but it has to do with me.'*

IMPACT ON TEACHER ATTITUDES AND INSTRUCTIONAL PRACTICES

At this stage of the implementation, it is evident that teachers are experiencing learning anxiety, and are having to deal with the extra work required with the new program. Teachers commented:

- Teachers are helping students learn how to learn a different way.

> *I needed to learn how to help my kids work in teams effectively. I needed to learn how to be a facilitator, which is something I'm still working on because it is hard to get away from standing in front of the room and telling people what to do instead of just getting to the side, moving off to the side and letting them try to figure things out first; so that part is different. Pacing is really difficult; still now, trying to figure out how much time is enough time and how much time is too much time to make them figure things out and stuff.*

At middle school site
- Teachers in the middle school tend not to supplement the curriculum.

It's our only curriculum, and we don't need to do much supplementing at all. And we're all on the same page on that.

- Teachers are discovering their own comfort levels with the curriculum.

It was interesting because when we first used the program one of our eighth grade teachers felt very uncomfortable having kids sit in groups all the time, and so she had her straight rows. Then she would have them put their desks together in pairs when they need to do group work, which is fine; and then had them move them back again. Well, at the end of the year she got tables for the following year. You know, her comfort level had gone higher.

We have a new teacher, and right now his, he's got straight rows. Because he…the first week he tried putting his room like mine, and he was not ready for that yet. And so he, the desks are in rows, but when the kids are working activity, they move them together, and by the end of the year, he'll be, I am sure he will have his kids sitting in groups because you just have a better comfort level, and you know how handle the kids better

- Some teachers question whether the new curriculum pushes teachers beyond their content knowledge.

OVERALL SITE SUCCESSES TO DATE

- Documented gains in student achievement

And we also have a lot of test data that supports—boy, our kids are doing better. They're not sliding back. They're doing better each year. And like my school, I take a lot of pride in this, we have more free and reduced lunch, we're getting more English as a Second Language kids—we should not be getting better scores. We are!

- Real life applications

As far as kids go, you are not going to have them say, 'Oh I love working hard and thinking a lot.' They are not going to do that. But what I have not heard, in the six years, now seventh year, yeah, is this the seventh year? Seventh year we've been using this, I've not heard the kids say, whine about, 'When are we ever going to use this stuff?' Have not heard it, have not heard it because it's embedded, it's in here. They get it. And the second thing is, 'Math is so boring.' It is not. It's kind of like a reverse check-off thing: I don't hear those things, I know the kids are responding well, and they get a sense of pride when they get good grades or they get their work done and the get it. And you can just see the hots. And they're on task. They're on task 46 minutes. It's never like, 'Oh, when is this class over?' Never. It's like, 'Oh! It's time to go!'

- Parents are gaining a comfort level with the curriculum.

The parents actually said that they got confused. And now, after—and it was new to them. They had no background whatsoever. Now, this year the parents response is, 'I really kind of like this. They are sharing math with us more at home here than ever.' The parents look forward to the study links!

Children are more interactive among themselves, helping one another out.

> *And the other thing that I'll find is if a student, let's say Matt, is having a problem, well, Lucy starts helping Matt out. Students have a tendency to teach each other. Last year, the very first year in, I had a group of five high-potential children in a room. And you know how sometimes kids will compete against each other? That's almost non-existent. It's a matter of, OK, Nguyen sees that Jenny is having a problem, and she's immediately over there, working through it with Jenny. Well, the next problem out, Nguyen might be having a problem. Well, Jenny goes over there, and she's starting to help. I see so much more student cooperation*

The new curriculum promotes interaction and a better mathematics experience for children, according to several teachers.

> *The benefits have been enormous. I think we have better teaching happening. Students' experiences in math classes are significantly different than they were. Math doesn't look like it used to. In fact some kids who are from the old system don't feel that they are really learning math anymore. That has been a real struggle watching kids try to figure out this is math. I think we have more collaboration in my high school than we ever had. My guess is that the experience in our other schools is identical. We collaborated all of the time. I'm not sure that that is happening everywhere but I know that that happened. And I really think that this curriculum and the way we did it probably created a sort of a survival mentality in our department. And when you do that you don't want to go alone.*

According to parents the standards-based mathematics curriculum has helped students who might otherwise have difficulties with mathematics.

> *The benefits to my kids has been that it is more practical math. Sarah being not a reader, that is my high schooler, always struggled with word problems, and one of the things that integrated math asked her to do was it gave her numbers and asked her to make a word problem. And all of a sudden the whole word problem clicked for Sarah, because it was like the curriculum asked her to do it backwards, which, for her, was great! It finally taught her what words go into making a problem. So all of a sudden, in middle school, it was really fun seeing this light bulb go on. Late or not, this light bulb went on for her, and all of a sudden, word problems were not quite so hard anymore. That was exciting.*

OVERALL CHALLENGES THAT REMAIN

Teacher preparation time has been a huge challenge.

> *Overall what have been the greatest challenges to implementing the curriculum? Prep time. That first year it was about four or five hours every single night and that was not including grading papers, not including anything else. Just to get ready for the next day: four or five hours. It is just going through it and making sure that you have an idea what you want the kids to try first, and when you're going to come in, and ... You know, just to get an idea how the flow of the class is going to work and how much you are going to get through in that hour, and just trying to figure it all out. It took a lot of time*

DISTRICT 8 PROFILE

BACKGROUND AND SETTING

District and site characteristics - The district is a small, rural school district with strong leadership in place. District leadership plays a strong and engaged role in the district. In recent years, school administration became concerned with poor student achievement on math tests. Strong parent involvement and teacher commitment also gave rise to a generalized feeling that scores on standardized tests should have been much higher. The recent adoption of statewide graduation standards provided additional impetus to a staff that was already interested in a standards-based mathematics curriculum. Prior to NSF-funded curriculum adoption, no uniform curriculum was used.

District 8

Location	West Central Minnesota
Enrollment	517
Percent eligible for free or reduced lunch	35%
Percent with limited English proficiency	0
Student mobility	8%
Percent enrolled in special education	13%
Percent passing Grade 8 Basic Skills Test	Reading 79% Math 64%

Source: Minnesota Department of Children, Families & Learning, 2001. Data center.

THE CURRICULUM ADOPTION PROCESS

The decision to adopt new mathematics curricula was initiated by the superintendent who provides several administrative functions in the district. The recent institution of the Minnesota graduation standards lent impetus to the superintendent's and the math committee chair's determination to institute a standards-based mathematics program. In fact, the superintendent preempted the regular adoption cycle to allow for the mathematics adoption to occur, which was not up for curriculum review at the time.

Major elements of the adoption process - The adoption process for the district took one year. The superintendent was resolute about full and complete adoption in the shortest possible amount of time. The adoption process included four major elements, with some variation across the elementary and secondary sites:

1. The curriculum committee. Composed of teachers who were selected by invitation of the superintendent and led by an influential teacher-leader.* Both elementary and secondary staffs were included on the committee.

Variation - The mathematics committee was afforded great autonomy. All interested teachers were invited to review curricula and make comments, however, only the committee members were allowed to vote for the final selection of curricula.

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* This person plays many important roles in this small district, serving as department chair, part-time technology coordinator, Best Practices teacher, and lead teacher.

2. Committee members approached textbook representatives at conferences they attended to peruse the various options available.

3. Committee members visited school sites that were implementing various mathematics curricula.

Variation - The visits varied in terms of which teachers participated, which grade level, and which curricula were observed.

4. At all grade levels, the committee members selected the mathematics curricula that were to be adopted.

Key players - The superintendent and a teacher-leader played strong roles during the curriculum adoption process. The superintendent wanted full adoption to occur within one year and worked together with the teacher-leader and other committee members to select appropriate curricula. The teacher-leader initiated discussions about mathematics education in the district and piloted materials prior to adoption cycle activities. Elementary and middle school teachers played moderate roles in the adoption process: participating through committee work, meeting to discuss concerns about the previous curricula and identifying objectives of a new curriculum, attending conferences, and observing teachers in other districts. Principals, publisher representatives, and parents played supporting roles in the adoption process, but had little direct influence upon the process.

KEY ISSUES DURING THE ADOPTION PHASE

There were some common issues that arose across all schools and grade levels, including:

For all grades

- The superintendent wanted speedy and full implementation of the new math curricula. The teachers felt pressure to select and implement new math curricula perhaps without fully exploring options or considering possible ramifications.

> *We did everything all in one year. It would have been a much easier transition if we'd had had two years, but we didn't. I think if we'd had one more year, first of all, we would have had that study year and I think we would have done it just a little bit differently. Adopting curricula like Investigations, CMP, and Core Plus, ones where you really need time to sit down as a staff and really look at it. We didn't have that.*

- Curriculum committee was formed by invitation of the superintendent. Only the committee had the right to vote on the adoption. This seemed to be an acceptable practice.

> *I believe the math committee went through the process of looking at what was out there. Then they would report back to us. It was not taken as a vote. They made the choice, and that's what our curriculum committees do.*

- There was a feeling that the Minnesota graduation standards drove the process.

> *Sometimes the Minnesota standards took over, sometimes they took precedence.*

Specific to the high school site

- One person nearing retirement preferred not to engage in the new curriculum. The school made the decision to make accommodations whereby the teacher could continue to teach traditional classes as the implementation was being rolled out over three years.

As the implementation at the high school required three years to complete, she could maintain the original curriculum and teach the higher secondary grades.

- After the completion of the third year of implementation at the high school, a decision needed to be made about calculus and advanced math courses. Teachers are currently reviewing whether to continue a traditional mathematics track in calculus or move to adopt *Core Plus 4*.

- There was a concern that the program was difficult for students, and lacked some information in certain areas. The teachers supplemented topics if they felt it was necessary.

THE EARLY IMPLEMENTATION PROCESS

The elementary (K-5) teachers were expected to begin implementation of *Investigations* in the fall of 1998. The middle school (6-8) teachers were expected to begin implementing *CMP* in the fall of 1998. The high school teachers began implementation at ninth grade with the introduction of *Core Plus 1*. This was to be followed annually with the additions of *Core Plus 2*, and *Core Plus 3*. At present, teachers at elementary, middle and high schools enjoy teaching the integrated program but still struggle to break away from instructional practices associated with a traditional approach.

Major Implementation activities - Five major types of implementation activities have occurred to date that vary by school grade level and by implementation year.

1. Three days of initial training of all elementary teachers and some paraprofessionals some in August prior to implementation in fall 1998. Elementary teachers received training from teachers from other districts experienced in the reform curriculum. Training for the high school math teachers included five days in the summer prior to each grade adoption, which was conducted by *Core Plus* trainers off-site.

   Variation - The training sessions varied by school levels in terms of the amount of experiential immersion in the curriculum versus planning of teaching lessons, assessment, and use of equipment such as graphing calculators. Generally, elementary and middle school teachers recall feelings of conviction in the new approach and excitement after receiving the initial training, although high school teachers characterized the initial training as an "introduction" to the new materials.

   Since the initial implementation, all new staff are expected to attend a four- to five-day summer training session on *Investigations*, *CMP*, or *Core Plus*.

2. Follow-up sessions and common planning time for teachers to meet and interact were held. At the elementary level, meetings occurred once a month the year prior to and during the first year of implementation. Teachers lament that with each subsequent year of implementation fewer meetings are being convened. Teachers indicate a desire to continue these meetings, and indicate that they have been beneficial. Elementary teachers continue to have a common planning time lasting one-half hour in the mornings.

   Variation - the high school did receive a follow-up session two months (November, 1998) after the curriculum was implemented. This session was led by a *Core Plus* trainer and its purpose was to introduce the next level of the *Core Plus* curriculum. Some teachers felt the presentation provided some unexpected assistance and indicated that they were grateful for any additional in-service training. The high school staff currently has no common planning time and tend to hold informal meetings instead.

3. Organized consultation and support. The superintendent is very supportive of professional development and encourages teachers to share information with each other. Most teachers respond that they are able to attend the workshops and conferences that they are interested in attending.

   Variation - Teachers attended a math conference in Duluth, *CMP* and *Core Plus* training conferences and other workshops. Hiring substitute teachers to cover teachers did not present a barrier to teachers attending staff development activities. Last year the school district used two percent of its budget for staff development.

4. Parent education.

   Variation - In the elementary school, parents were invited into the classrooms for a question and answer period. Parents of high school students received newsletters informing them of the curricular changes taking place in mathematics. Many parents attended school meetings. In October, during the first year of implementation, parents at all grade levels were invited to a general meeting to discuss issues related to the new curriculum. There they were presented with specific examples of what is taught in the classroom.

Key players - The district is in its third year of implementation. While the superintendent working closely with a teacher-leader played significant roles in the adoption process, teachers were the main implementers of the new math curriculum. They made use of each other's knowledge gained from participating in various workshops.

Major implementation issues - Both common and unique issues have emerged at the elementary school and high school levels. In some instances the issues remain unaddressed. Common issues and actions to date include:

For all grades

- Concern for special education and poorer students

- Teachers of all grade levels expressed the desire for enhanced and on-going training. The teachers believed it would be especially helpful to have follow-up sessions. They wanted to have the opportunity to raise questions after they had acquired some experience teaching the program.

  > *As teachers, you need to collaborate with each other. We didn't do any staff training other than the three-day session. An hour here, or a discussion there would be helpful indeed just to keep the belief going!*

- Increased workload

- They must acquire and use alternate teaching and grading styles

- A number of key staff, including paraprofessionals, and substitute teachers have not been able to effectively support the new math initiative because of their lack of involvement in the initial training sessions. [Following our data-gathering school year, the district did hold a workshop for substitute teachers.]

- The parents have indicated some concern with the new math curricula. They are unsure of how to help their students, as they cannot see the sequence required, and are used to a traditional math program. They are uncomfortable with how their students will apply their knowledge and succeed.

School staff at all levels is sensitive to this issue and would like to assist the parents. To date, there has been no implementation strategy that should center on instructing the teachers on how to help the parents.

> *The transition from the traditional to the new curriculum has been hard for parents who tend to say, 'This is not the way we were taught.'*

Specific to the elementary site

- Full implementation was expected in grades K-8. Different programs were used for elementary and middle school. Teachers felt uncomfortable with the speed of implementation and felt that they did not have enough time to communicate with the teachers of the other grades.

> *I'm probably having the most problem with the special education—how much homework to give them, what they should be required to do. The first couple of years the special ed kids usually got A's and B's in class. And now this year, it's getting a little bit more difficult, a little heavier stuff, and they're starting to get C's and they're frustrated.*

Specific to the high school site

- There has been an escalating realization that successful implementation requires adequate time to be fully developed, appreciated, and for significant change to occur.

> *When you implement a new curriculum, you have to give it time, no matter what. Some teachers feel they only begin to understand the nuances of teaching the new curriculum after two to three years.*

- At the high school there is a important concern with how to assess the students. Curricular materials do not appear to contain adequate instruction on how to assess levels of learning.

> *I guess learning a different way of grading, because you have to look at the explanation.*

- There is concern with curriculum materials especially calculators.

> *I guess the main thing is look at the curriculum, see the accessories and make sure you have the right accessories. We want enough calculators so that the kids can check one out all year, like a book. People have suggested that we'll give them to the 11th and 12th graders and have the other kids use the Casios. And to me, that's not going to work. They'd be so used to the Casios, that when they get to the graphing calculators, they're not going to want to switch.*

- There is a desire to get all teachers on board. If this is not possible, once teachers who object to the integrated program retire, new staff hires could be required to accept the new math curriculum.

> *In fact, some of them will never be on board for a variety of reasons. I would say that when we adopted it, we had all but two teachers really on board.*

IMPACT ON TEACHER ATTITUDES AND INSTRUCTIONAL PRACTICES

At this stage of the implementation, it is evident that teachers are experiencing learning anxiety, and are having to deal with the extra work required with the new program. Teachers commented:

> *It isn't a problem with the adoption it is that you are moving from a comfort zone as I had as a teacher and as a parent to something that I don't understand.*
>
> *Well, last year I was thrown into this curriculum and I didn't have the training for it. Because first of all, I didn't know where the curriculum was going. I didn't understand it quite right. I was trying to keep up with the kids a day ahead and it was really difficult.*
>
> *This is the first year that I really truly understand it. It has taken me three years of teaching it. We have some new teachers and when they are frustrated, I share with them the fact that it took me three years to catch on.*

Also evident is the magnitude of change that teachers must deal with in terms of how they themselves learned mathematics, how they learned to teach it, and how their practice has changed in order to support the new curriculum:

> *They do a lot of writing, so you do have to be on top of it. It's not that they're doing the computation, but they're doing a lot of writing, explaining. And so staying on top of all that, that's probably the biggest challenge. And wanting them to come up with the right answer. That's been kind of built into us. The strategy is what we need to be always thinking of. It's the process. And that's in all curricular areas. And that's a big change.*
>
> *Traditional math, you do the computation and it's got to be on paper. And there was no room for, "How did you get that?" I guess what I really like about it is at the end of that time they've been working with it, pulling them back together and finding out what their strategies were. What did you do? It gives you a chance to revisit. You do come back. Whereas, I felt in the other way, you spent the two weeks and you go on, and if they didn't get it, too bad and that's it. And I really think that this accommodates the individual.*
>
> *You have to learn how to ask questions, instead of saying, "Okay, what's this times this?" That's the one thing I love about this curriculum is that they explain all the answers.*
>
> *The ultimate is mental. We want them to get to be able to just do it. But in order to get there, we have to know where their thinking is going.*

At the same time, for most teachers, the new curriculum has reinforced where they were going in their practice:

> *I finally put the book away and tried to do my own thing—trying to incorporate a whole lot of other math not strictly by the book.*
>
> *I'm finding that I am just enjoying this math, in that it has opened doors for me, personally. And I'm feeling good about my capabilities in math, where I really didn't before.*
>
> *I get to know my students much better using this system.*

Teachers are also starting to make some preliminary observations of the impact of the new curricula on their students:

> *Students were angry with the implementation at first. They have come to accept and enjoy it. You had your Math students who did well and you had a whole bunch who did not have any understanding at all. And I think, in the switching over, it was probably the very good students—the ones who were good at the rote—that fought it the hardest.*
>
> *More reasoning, analysis, group cooperation. More math thinking and applying, rather than memorizing.*
>
> *Most students appear to be excited by the new curriculum. I haven't had a kid cry in math since we started. I used to. All but about two kids have math as their favorite time of the day. That never used to happen. You wouldn't expect that at fourth grade. Even some of the special ed kids are putting math as their favorite time of the day.*
>
> *I think they're much better collaborative workers, working together in groups because they spend most of the time in groups or pairs. You see a lot of skill being built in that area.*
>
> *Initially, I think they were uncomfortable with sharing. Perhaps, they felt that they wouldn't be right. They had to get used to that; explaining and sharing. And I think that's been the biggest change.*
>
> *I also see it carrying over into their writing. They're getting better at explaining their thinking.*

OVERALL SITE SUCCESSES TO DATE

- The adoption process appears to have resulted in the teachers developing a strong identity with the reform curricula chosen.

- Teachers report that they like using the reform curricula. Teachers suggest that they are excited by the new program and feel that it gives them the opportunity to get to know their students better.

- Teachers appear to be developing their own methods for solving issues that have surfaced while using the new curriculum

> *I made instruction books for the Casios, so that the kids have them. So that made more work for me.*
>
> *I walk around with a clipboard when they are doing something that is important. You need to be going around to the middle of them or you are missing the boat. The actual instruction is maybe 10, 15 minutes and then they are on their own working in groups, individually, whatever; they're doing a lot of hands-on things.*

- Teachers report that there is a move on their part to fill more of a facilitative role for the students as this encourages more group interaction, sharing amongst the students; and in the teachers' opinion leads to improved higher level thinking skills.

- There has been a documented improvement in both elementary and secondary math test scores.

- Teachers note that students seem much more engaged with math education, and many are opting to enroll in four years of math.

- The new curricula provide a more standards-based approach to math education needed to fulfill the Minnesota graduation standards.

OVERALL CHALLENGES THAT REMAIN

- There is a continuing need for organized follow-up training and support among teachers to assure full implementation of the new curricula, including the assessment of student learning and mastery.

- Teachers need time for active communication with each other to re-ignite their enthusiasm and trouble shoot.

- Parents may have needs that have not been systematically identified and addressed. There is a need to assist the teachers in developing strategies for helping the parents.

- Other staff in the school, including teachers of special education, substitute teachers, and paraprofessionals, need training regarding the new curricula in order to support its implementation in the classroom and with parents.

- There is an ongoing need to assess math curricula at the high school level as new grades are brought on board.

Appendix C: Survey of Mathematics Teachers
Spring 2001

Key: (#) = Frequency

A. *Demographics*

1. Sex **20.3% (90)** Male **79.7% (354)** Female

2. What degrees do you hold?

9.6%	**(43)**	Bachelor's degree **without** specific teacher training/certification courses
48.4%	**(217)**	Bachelor's degree **with** specific teacher training/certification courses
10.9%	**(49)**	Master's degree **without** specific teacher training/certification courses
37.1%	**(166)**	Master's degree **with** specific teacher training/certification courses

3. What was your major for your bachelor's degree? (*please check all that apply*)

70.3%	**(315)**	Elementary education
12.9%	**(58)**	Mathematics education
9.4%	**(42)**	Mathematics
21.7%	**(97)**	Other (please specify)

4. What was your minor or emphasis for your bachelor's degree? **78.1% (350)** entered something

5. Do you hold Minnesota teacher certification in mathematics? **29.2% (128)** Yes **70.8% (310)** No

6. What other Minnesota teaching licenses do you currently hold? **39.7% (178)** entered something

7. Including this year, how many years have you been teaching? The distribution is bi-modal at **2** and **3** (but close to quatre-modal), thus jagged with modest negative skew, **Mean = 15.36, S.D. = 10.45**, and **Median = 13.**

8. Including this year, how many years have you been teaching in your current school district? The distribution is jagged with modest negative skew, **Mean = 12.82, S.D. = 10.26, Mode = 2**, and **Median = 10.**

9. Including this year, how many years have you been teaching at your current school? The distribution is jagged with strong negative skew, **Mean = 8.85, S.D. = 8.09, Mode = 1**, and **Median = 5.**

10. Including this year, how many years have you been teaching mathematics? The distribution is jagged with negative skew, **Mean = 14.31, S.D. = 10.48, Mode = 3**, and **Median = 12.**

11. Please indicate the grades in which you are teaching mathematics this year by *circling all that apply*

K 1 2 3 4 5 6 7 8 9 10 11 12

Elementary = (346), Middle School/Junior High = (47), Senior High = (55)

12. How many days per week do you teach mathematics? (*Circle one*) 1 2 3 4 5

Mean = 4.9, S.D. = 0.43, Mode = 5, and **Median = 5.**

13. On average, how many minutes per day do you teach mathematics?

For elementary teachers: .... Mean = 58.74, S.D. = 24.07, Mode = 60

B. *Your Teaching and Classroom Activities*

14. About how often **do students in your class** take part in each of the following activities as part of their mathematics instruction? *(check one box for each item)*

	In all or almost all lessons	Often: once or twice a week	Sometimes: once or twice a month	Rarely: a few times a year	Never
a. Participate in whole class discussions with the teacher to further mathematical understanding	**84.7%** **(376)**	**12.6%** **(56)**	**1.4%** **(6)**	**0.7%** **(3)**	**0.7%** **(3)**
b. Share ideas or solve problems in small groups	**45%** **(198)**	**45.2%** **(199)**	**8.6%** **(38)**	**0.7%** **(3)**	**0.5%** **(2)**
c. Share problem solving strategies with the whole class	**50.5%** **(222)**	**41.1%** **(181)**	**6.6%** **(29)**	**1.6%** **(7)**	**0.2%** **(1)**
d. Make formal presentations to the class	**16.9%** **(75)**	**19%** **(84)**	**26.2%** **(116)**	**28.9%** **(128)**	**9%** **(40)**
e. Read from a mathematics textbook in class	**23%** **(101)**	**21.6%** **(95)**	**8.4%** **(37)**	**10%** **(44)**	**37%** **(163)**
f. Read other, non-textbook mathematics-related materials in class	**5.2%** **(23)**	**18.3%** **(81)**	**34.1%** **(151)**	**30.9%** **(137)**	**11.5%** **(51)**
g. Practice routine computations or algorithms	**36%** **(160)**	**39.8%** **(177)**	**14.4%** **(64)**	**6.1%** **(27)**	**3.8%** **(17)**
h. Answer textbook or worksheet questions individually	**37.5%** **(167)**	**40.4%** **(180)**	**11.5%** **(51)**	**7.6%** **(34)**	**2.9%** **(13)**
i. Engage in hands-on mathematics activities or games	**41.7%** **(185)**	**42.8%** **(190)**	**13.5%** **(60)**	**2%** **(9)**	**0.0%** **(0)**
j. Design or implement their own investigation	**6.4%** **(28)**	**24.1%** **(106)**	**35.5%** **(156)**	**29.4%** **(129)**	**4.6%** **(20)**
k. Work on mathematics investigations or projects lasting a week or more	**4.3%** **(19)**	**14.8%** **(66)**	**33.7%** **(150)**	**35.7%** **(159)**	**11.5%** **(51)**
l. Collect, record, represent, and analyze data	**10.3%** **(46)**	**27.6%** **(123)**	**43.4%** **(193)**	**16.6%** **(74)**	**2%** **(9)**
m. Write a description of a plan, procedure or problem-solving process	**7.9%** **(35)**	**30.4%** **(135)**	**34.2%** **(152)**	**18.2%** **(81)**	**9.2%** **(41)**
n. Write reflections in a notebook or journal	**3.6%** **(16)**	**19.7%** **(88)**	**28.4%** **(127)**	**28%** **(125)**	**20.4%** **(91)**
o. Take short answer tests, e.g., multiple choice, true/false, fill-in-the-blank	**2.5%** **(11)**	**11.9%** **(53)**	**32.4%** **(145)**	**27.1%** **(121)**	**26.2%** **(117)**
p. Take tests requiring open-ended responses, e.g., descriptions, explanations	**5.2%** **(23)**	**17.9%** **(80)**	**46.6%** **(208)**	**17.7%** **(79)**	**12.6%** **(56)**
q. Engage in performance tasks for assessment purposes	**5.4%** **(24)**	**25.4%** **(113)**	**53.7%** **(239)**	**13.7%** **(61)**	**1.8%** **(8)**

15. About how often **do you** do each of the following in your mathematics instruction?
(check one box for each item)

	Almost every day	Often: once or twice a week	Sometimes: once or twice a month	Rarely: a few times a year	Never
a. Use the standards-based curriculum designated instructional materials as the basis for lessons	**73.3%** **(326)**	**15.5%** **(69)**	**6.1%** **(27)**	**3.6%** **(16)**	**1.6%** **(7)**
b. Introduce content through formal presentation or lecture	**29.9%** **(132)**	**40.7%** **(180)**	**16.5%** **(73)**	**8.4%** **(37)**	**4.5%** **(20)**
c. Explain or demonstrate step-by-step procedures for solving problems	**35%** **(156)**	**42.8%** **(191)**	**15.5%** **(69)**	**5.8%** **(26)**	**0.9%** **(4)**
d. Encourage students to explain their reasoning when giving an answer	**69.8%** **(312)**	**25.7%** **(115)**	**4.5%** **(20)**	**0.0%** **(0)**	**0.0%** **(0)**
e. Encourage students to explore alternative strategies for solving problems	**55.5%** **(248)**	**35.1%** **(157)**	**9.2%** **(41)**	**0.2%** **(1)**	**0.0%** **(0)**
f. Encourage students to use multiple representations, e.g., numeric, graphic, pictorial, geometric	**34.9%** **(155)**	**43.5%** **(193)**	**17.3%** **(77)**	**3.2%** **(14)**	**1.1%** **(5)**
g. Help students see the connections between mathematics and other subject areas	**33.5%** **(149)**	**46.1%** **(205)**	**18.7%** **(83)**	**1.6%** **(7)**	**0.2%** **(1)**
h. Help students see connections between mathematical concepts within the mathematics	**37.8%** **(168)**	**45.2%** **(201)**	**14.2%** **(63)**	**2.5%** **(11)**	**0.4%** **(2)**
i. Assign mathematics homework	**39.7%** **(177)**	**39.9%** **(178)**	**11.2%** **(50)**	**5.6%** **(25)**	**3.6%** **(16)**
j. Supplement the standards-based curriculum with other materials on a small scale such as worksheets or Mad Minutes	**22.1%** **(98)**	**43.1%** **(191)**	**19.9%** **(88)**	**10.2%** **(45)**	**4.7%** **(21)**
k. Supplement the standards-based curriculum with other materials on a larger scale such as whole units	**6.6%** **(29)**	**17%** **(75)**	**22.6%** **(100)**	**31.7%** **(140)**	**22.2%** **(98)**

C. *Your Views and Opinions*

16. Please indicate your opinion about each of the following by checking your degree of agreement with each statement.

	Strongly Agree		Neither Agree Nor Disagree		Strongly Disagree
a. Students generally learn mathematics best in classes with students of similar abilities	**12.6%** **(56)**	**26.5%** **(118)**	**26.7%** **(119)**	**24.3%** **(108)**	**9.9%** **(44)**
b. Most teachers in my school support our standards-based mathematics curriculum as a good approach to teaching mathematics	**20.5%** **(91)**	**44.7%** **(198)**	**23.5%** **(104)**	**8.6%** **(38)**	**2.7%** **(12)**
c. I am well informed about the Minnesota basic and graduation standards for the grades I teach	**38.1%** **(169)**	**41.1%** **(182)**	**12.6%** **(56)**	**6.8%** **(30)**	**1.4%** **(6)**
d. The Minnesota basic and graduation standards include important mathematics for the grades I teach	**25.1%** **(111)**	**42.4%** **(188)**	**22.6%** **(100)**	**6.5%** **(29)**	**3.4%** **(15)**
e. I am well-informed about the National Council of Teachers of Mathematics standards for the grades I teach	**19.5%** **(87)**	**30.4%** **(136)**	**23%** **(103)**	**20.6%** **(92)**	**6.5%** **(29)**
f. It is important for students to learn basic mathematics skills before solving problems	**33.1%** **(147)**	**27%** **(120)**	**16.2%** **(72)**	**17.6%** **(78)**	**6.1%** **(27)**
g. My principal supports my involvement in professional development in mathematics	**55.3%** **(246)**	**30.8%** **(137)**	**11.5%** **(51)**	**1.3%** **(6)**	**1.1%** **(5)**
h. Professional development programs in my district are sustained over time with ample follow-up activities and experiences	**18.6%** **(82)**	**30.1%** **(133)**	**28.7%** **(127)**	**19.2%** **(85)**	**3.4%** **(15)**
i. Hands-on experiences do not improve student achievement enough to be worth the time and expense	**2.9%** **(13)**	**3.6%** **(16)**	**6%** **(27)**	**21.5%** **(96)**	**66%** **(295)**
j. Students' conversations which include sharing and explaining their thinking are essential to their understanding mathematical ideas	**66.9%** **(299)**	**27.5%** **(123)**	**3.8%** **(17)**	**0.2%** **(1)**	**1.6%** **(7)**
k. Calculator use should be incorporated only after the mastery of basic arithmetic facts and algorithms	**14.3%** **(64)**	**19.7%** **(88)**	**23.3%** **(104)**	**26.8%** **(120)**	**15.9%** **(71)**
l. Some students have an aptitude for mathematics and other do not	**11.6%** **(52)**	**35.3%** **(158)**	**21.9%** **(98)**	**20.1%** **(90)**	**11%** **(49)**
m. Students need repeated practice to master and retain mathematical algorithms	**30.4%** **(135)**	**47.1%** **(209)**	**15.1%** **(67)**	**4.5%** **(20)**	**2.9%** **(13)**
n. Reform efforts in mathematics education are just another passing fad	**2.2%** **(10)**	**12.3%** **(55)**	**36.1%** **(161)**	**29.6%** **(132)**	**19.7%** **(88)**
o. All students can achieve the Minnesota basic standards in mathematics	**14.8%** **(66)**	**35.5%** **(158)**	**22.9%** **(102)**	**18.9%** **(84)**	**7.9%** **(35)**
p. All students can achieve the Minnesota graduation standards in mathematics	**9.2%** **(41)**	**32.7%** **(146)**	**27.5%** **(123)**	**21.3%** **(95)**	**9.4%** **(42)**
q. Students benefit from regularly writing about mathematics in a journal or notebook	**19%** **(85)**	**40%** **(179)**	**36%** **(161)**	**4.3%** **(19)**	**0.7%** **(3)**

17. Please indicate which of the following standards-based curricula you have experience teaching by placing a check in Column A. For each curriculum you have taught, please indicate the number of years in Column B. *(check all that apply)*

	Column A Have ever taught	**Column B Number of years taught, including this year**
High School		
a. Contemporary Mathematics in Context (CPMP or Core Plus)	**12.5%** **(56)**	
b. Integrated Mathematics: A Modeling Approach Using Technology (SIMMS)	**3.3%** **(15)**	
c. Interactive Mathematics Program (IMP)	**7.4%** **(33)**	
d. MATH Connections, a Secondary Mathematics Core Curriculum	**3.3%** **(15)**	
e. Mathematics: Modeling Our World (ARISE)	**3.8%** **(17)**	
Middle School Level		
f. Connected Mathematics (CMP)	**13.4%** **(60)**	
g. MATH Thematics (STEM)	**9.4%** **(42)**	
h. Mathematics in Context (MiC)	**3.1%** **(14)**	
i. MathScape (STM)	**3.1%** **(14)**	
j. Middle-School Mathematics through Applications (MMAP)	**3.3%** **(15)**	
Elementary School Level		
k. Everyday Mathematics (EM or UCSMP or Chicago Math)	**43.3%** **(194)**	
l. Investigations in Data, Number, and Space	**33.3%** **(149)**	
m. Math Trailblazers (TIMS)	**3.6%** **(16)**	

18. Which, if any, of these curricula listed in question 17 are you teaching this year? *(please write the letter(s) associated with the curriculum in the space to the right)* **Mode** was **k. Everyday Math** at **159 or 35.5%**

19. Are you teaching mathematics this year using curricula other than those listed in question 17?
35.6% (150) Yes **64.4% (271)** No

If yes, please specify the course name(s):

If yes, please specify the title and publisher of the curriculum:

NOTE: IF YOU HAVE EVER TAUGHT ANY OF THE CURRICULA LISTED IN QUESTION 17 IN YOUR CURRENT DISTRICT, PLEASE COMPLETE QUESTIONS 20 THROUGH 29. IF, HOWEVER, YOU ARE NOT TEACHING ANY OF THE LISTED CURRICULA THIS YEAR, STOP HERE.

D. *Curriculum Adoption*

The next two questions ask about issues related to the process your current district used in the adoption of your standards-based mathematics curriculum.

20. Please indicate your opinion about each of the following by checking your degree of agreement with each statement.

	Strongly Agree		Neither Agree Nor Disagree		Strongly Disagree	N/A or Don't Know
a. The district involved all appropriate groups and persons when making the adoption decision	**24.2% (101)**	**28.9% (121)**	**12.9% (54)**	**8.9% (37)**	**4.1% (17)**	**21.1% (88)**
b. Teachers in my building had sufficient opportunity to be involved in the adoption decision	**23.3% (97)**	**28.3% (118)**	**15.6% (65)**	**8.6% (36)**	**5.3% (22)**	**18.9% (79)**
c. Teachers in my building took an active part in the adoption process	**20.6% (86)**	**28.5% (119)**	**17% (71)**	**10.5% (44)**	**4.8% (20)**	**18.7% (78)**
d. I received good information about why the district chose our current standards-based curriculum	**26.6% (111)**	**38.3% (160)**	**11.7% (49)**	**9.8% (41)**	**5.7% (24)**	**7.9% (33)**

21. Please rate the importance of each of the following factors in the your district's decision to adopt your current standards-based mathematics curriculum.

	Very Important		Important		Not Important	N/A or Don't Know
a. Wanting to better align our curriculum to National Council of Teachers of Mathematics standards	**31.2% (130)**	**20.6% (86)**	**21.3% (89)**	**1.7% (7)**	**0.5% (2)**	**24.7% (103)**
b. Wanting to better align our curriculum to Minnesota graduation standards	**47.2% (197)**	**19.9% (83)**	**14.9% (62)**	**1.2% (5)**	**0.7% (3)**	**16.1% (67)**
c. Needing to adopt new materials because it was mathematics' turn in the curriculum adoption cycle	**18.5% (77)**	**16.1% (67)**	**20.7% (86)**	**13.5% (56)**	**11.3% (47)**	**20% (83)**
d. Wanting to improve students' test scores in mathematics	**40.3% (168)**	**23.5% (98)**	**17.7% (74)**	**2.6% (11)**	**1% (4)**	**14.9% (62)**
e. Wanting to offer students more opportunities to understand mathematics and apply it in solving real-world problems	**46.7% (194)**	**22.4% (93)**	**15.2% (63)**	**2.2% (9)**	**0.2% (1)**	**13.3% (55)**
f. Other (please specify)						

E. *Your Training and Professional Development*

22. Before implementing your current standards-based mathematics curriculum, how many days of formal training related to teaching the new curriculum did you have?

10.2%	**(42)**	None
6.8%	**(28)**	Less than one day
29.1%	**(120)**	One to two days
23%	**(95)**	Three to four days
12.8%	**(53)**	Five days
8%	**(33)**	Six to ten days
10.2%	**(42)**	More than ten days

23. Was the amount of training you had related to the new curriculum **prior to implementing** the standards-based mathematics curriculum (*check one*).

Less than was necessary	About right	More than was necessary
33.9% (137)	**62.6% (253)**	**3.5% (14)**

24. Since you began teaching the standards-based curriculum, please indicate how frequently you have participated in each type of follow-up training and support activity listed below.

	Very frequently	Frequently	A few times	Once or twice	Never
a. Participated in a follow-up training session conducted by my district's staff development personnel	**5.3%** **(22)**	**17.9%** **(74)**	**24%** **(99)**	**27.8%** **(115)**	**24.9%** **(103)**
b. Participated in a follow-up training session conducted by the curriculum publisher or an experienced user	**3.7%** **(15)**	**10.7%** **(44)**	**15.6%** **(64)**	**33.7%** **(138)**	**36.3%** **(149)**
c. Met formally with other teachers in my building to discuss math content, pedagogy, or individual lessons	**19.8%** **(82)**	**31.8%** **(132)**	**28.4%** **(118)**	**13%** **(54)**	**7%** **(29)**
d. Met formally with other teachers in my building to develop and score assessments	**5%** **(21)**	**16.8%** **(70)**	**28.8%** **(120)**	**19.4%** **(81)**	**30%** **(125)**
e. Met formally to examine student work	**3.6%** **(15)**	**8.9%** **(37)**	**31.3%** **(130)**	**24.1%** **(100)**	**32%** **(133)**
f. Observed a teacher in my district or another district teaching the curriculum I'm teaching	**2.9%** **(12)**	**3.1%** **(13)**	**11.1%** **(46)**	**20%** **(83)**	**62.9%** **(261)**
g. Met with an officially designated mentor to discuss my experiences teaching the curriculum	**4.6%** **(19)**	**6.7%** **(28)**	**11.1%** **(46)**	**8.4%** **(35)**	**69.2%** **(288)**
h. Consulted with more experienced teachers of the curriculum (by phone, e-mail, informal conversations, etc.)	**9.6%** **(40)**	**14.9%** **(62)**	**22.2%** **(92)**	**15.7%** **(65)**	**37.6%** **(156)**
i. Attended a session offered by a college or university relating to standards-based mathematics content or pedagogy	**2.6%** **(11)**	**4.8%** **(20)**	**8.4%** **(35)**	**18.2%** **(76)**	**65.9%** **(275)**
j. Attended a session offered by the MDCFL or SciMathMN relating to standards-based mathematics content or pedagogy	**1.7%** **(7)**	**2.4%** **(10)**	**8.2%** **(34)**	**13.5%** **(56)**	**74.3%** **(309)**
k. Attended a session of a state or national professional organization focused on our standards-based curriculum	**3.2%** **(13)**	**3.9%** **(16)**	**7.3%** **(30)**	**14.6%** **(60)**	**71%** **(291)**
l. Other (please specify)					

25. Of the follow-up training and support activities listed above in question 24, items a through l, which **two** did you find the most helpful to you for becoming more skillful in teaching the new curriculum?

Mode was 24c, 47.5% (213)

F. *Your Views and Opinions*

26. Please indicate your opinion about each of the following by checking your degree of agreement with each statement.

	Strongly Agree		Neither Agree nor Disagree		Strongly Disagree
a. I have difficulty determining student mastery of mathematics concepts using the standards-based mathematics curriculum	**6.7%** **(28)**	**22.7%** **(95)**	**24.2%** **(101)**	**35.6%** **(149)**	**10.8%** **(45)**
b. The standards-based mathematics curriculum we use meets the needs of high achieving students in mathematics	**24.5%** **(103)**	**44.7%** **(188)**	**13.3%** **(56)**	**11.9%** **(50)**	**5.7%** **(24)**
c. The standards-based mathematics curriculum we use meets the needs of students with special needs	**5.7%** **(24)**	**18.7%** **(79)**	**21.1%** **(89)**	**30.3%** **(128)**	**24.2%** **(102)**
d. The standards-based mathematics curriculum we use meets the needs of English language learners (ELL)	**2.4%** **(10)**	**15.4%** **(63)**	**33.7%** **(138)**	**27.1%** **(111)**	**21.5%** **(88)**
e. The standards-based mathematics curriculum we use meets the needs of the average mathematics student	**24.6%** **(103)**	**50.8%** **(213)**	**14.6%** **(61)**	**7.9%** **(33)**	**2.1%** **(9)**
f. It takes longer to cover the same or similar material using our standards-based mathematics curriculum compared to other curricula I have taught	**16.7%** **(70)**	**26.8%** **(112)**	**36.6%** **(153)**	**13.9%** **(58)**	**6%** **(25)**
g. Finding enough planning time is a problem with the standards-based mathematics curriculum	**22.5%** **(94)**	**38.4%** **(160)**	**17.5%** **(73)**	**18.9%** **(79)**	**2.6%** **(11)**
h. My students have a better understanding of the mathematics content I am teaching from the standards-based mathematics curriculum compared to other curricula I have taught	**22.8%** **(95)**	**31.5%** **(131)**	**29.3%** **(122)**	**12.5%** **(52)**	**3.8%** **(16)**

27. What has been the greatest change you have made in your teaching as a result of using the standards-based curriculum?

75.9% (340) wrote something

28. What has been the greatest challenge you have faced as you have implemented the standards-based curriculum?

79% (354) wrote something

29. What has been the greatest benefit, if any, to your students as a result of using the standards-based curriculum?

73% (327) wrote something

Appendix D: Classroom observations

District	1				2				3			
Date	5/3	5/3	5/3	5/3	2/26	2/28	2/28	4/19	4/3	4/3	4/3	4/3
Grade	10	10	MIXED	-	4	4	7	7	3	4	10	10
BeginTime	10:19	11:15	9:12	10:25	2:00	2:00	11:08	1:14	8:30	10:05	9:56	11:15
Course	CORE	CORE	CORE	CORE	INV	INV	CMP	CMP		MATH	CORE	CORE
EndTime	11:05			11:10	3:00	3:00	1:09	2:42	9:30	11:00	10:35	12:10
NumberMale	11		7	20	16	13	14	12	11	12	6	
NumberFem	10		13	7	11	17	9	10	14	12	7	
Observer	TDS	TDS	MM	MM	LCC	LCC	LCC	LCC	MM	MM	TDS	TDS
L												
LWR	10		5				10	16	8	3	1	
D			9	2								2
DI	5		3	4	19	13	4		8	10	1	6
TL			12	11					1		20	
TSP				4								
IW	26					28		5	39		4	1
CD							28	13		2	10	
SSP			14	20				23				43
PS					14		16			40		
SSS					25	10		7				
O	2		6	5	2	5	6	22		2	6	8
Total time	**43**	**0**	**49**	**46**	**60**	**56**	**64**	**86**	**56**	**57**	**42**	**60**
	46				**66.5**				**53.8**			
Rom2	3		2	2	0	3	3	2	2	3	2	1
Rom3	2		2	2	2	0	2	1	1	0	1	1
Rom5	1		2	2	3	2	3	3	1	3	1	0
Rom6	0		2	1	2	2	2	1	1	3	1	2
Rom7	2		2	1	2	2	2	2	1	3	0	0
Rom9	0		1	1	2	0	2	1	0	3	2	0
AVERAGE	**1.3**		**1.8**	**1.5**	**1.8**	**1.5**	**2.3**	**1.7**	**1.0**	**2.5**	**1.2**	**0.7**
District AVE	**1.6**				**1.8**				**1.3**			

Activity Codes

L	lecture
LWD	lecture with discussion
D	demonstration
DI	directions/instructions
TPS	teacher led problem solving
TSP	teacher solving problems
IW	individual work
CD	class discussion
SSP	small group solving problems
SPS	small problem solving groups
SSS	student strategy sharing
O	other

Romberg Observational Scale

Rom 2. The lesson fostered the development of conceptual understanding. (1-4)

Rom 3 Connections within mathematics were explored in the lesson. (1-5)

Rom 5 Students explained their responses or solution strategies. (1-3)

Rom 6 Multiple strategies were encouraged and valued. (1-5)

Rom 7 The teacher valued students' statements about mathematics and used them to build discussion or work toward shared understanding for the class. (1-5)

Rom 9 The teacher encouraged students to reflect on the reasonableness of their responses. (1-5)

District	4				5				6			
Date	5/17	5/14	5/1	5/17	4/18	4/18	4/18	4/18	4/3	4/2	4/16	5/9
Grade	4	4	10	10	4	4	8	8	4	4	10	9
BeginTime	12:50	12:50	9:05	10:00	10:30	1:02	11:15	9:30	12:40	12:40	9:46	1:20
Course	EM	EM	CORE	CORE	MATH	MATH	CMP	CMP	EM	EM	IMP 2	IMP
EndTime	1:50	1:50	9:55	10:40	11:11	1:44	12:04	10:19	1:45	1:45	10:41	2:10
NumberMale	6	9	14	12	11	10	11	9	13	5	9	9
NumberFem	7	8	10	10	9	8	13	11	13	7	9	18
Observer	LCC	LCC	LCC	LCC	TDS	TDS	TDS	TDS	LCC	LCC	LCC	LCC
L								2				
LWR	13	20		4	20	1					8	10
D	2	3		3								
DI		5		5	1	1		1	13	12	1	5
TL					1		13					
TSP								2	2			
IW	27	12		2	6		29	23		13	13	7
CD									1	8		2
SSP			42		3	9					10	
PS		13		8								24
SSS				2	6	28		2	17	12	18	
O	6	6	8	15		3	1	20	28	8	5	2
Total time	**48**	**59**	**50**	**39**	**37**	**42**	**43**	**48**	**61**	**53**	**55**	**50**
	53.5				**42.5**				**54.8**			
Rom2	1	2		2	3	3	3	2	2	0	3	3
Rom3	1	0		0	1	2	3	1	2	0	0	2
Rom5	1	2		1	2	3	3	1	3	3	3	3
Rom6	1	2		1	2	3	2	1	2	2	3	2
Rom7	1	2		1	2	3	3	2	2	2	2	3
Rom9	0	0		1	2	2	2	2	2	3	2	3
AVERAGE	**0.8**	**1.3**	**0.0**	**1.0**	**2.0**	**2.7**	**2.7**	**1.5**	**2.2**	**1.7**	**2.2**	**2.7**
District AVE	**1.1**				**2.2**				**2.2**			

Activity Codes

L	lecture
LWD	lecture with discussion
D	demonstration
DI	directions/instructions
TPS	teacher led problem solving
TSP	teacher solving problems
IW	individual work
CD	class discussion
SSP	small group solving problems
SPS	small problem solving groups
SSS	student strategy sharing
O	other

Romberg Observational Scale

Rom 2. The lesson fostered the development of conceptual understanding. (1-4)

Rom 3 Connections within mathematics were explored in the lesson. (1-5)

Rom 5 Students explained their responses or solution strategies. (1-3)

Rom 6 Multiple strategies were encouraged and valued. (1-5)

Rom 7 The teacher valued students' statements about mathematics and used them to build discussion or work toward shared understanding for the class. (1-5)

Rom 9 The teacher encouraged students to reflect on the reasonableness of their responses. (1-5)

District	7			8							
Date	4/9	4/9	4/18	5/22	5/22	5/22	5/22				
Grade	4	4	7	4	4	10	10				
BeginTime	9:30	10:20	12:49	9:35	10:15	10:10	9:15				
Course	EM	EM	STEM			CORE	CORE				
EndTime	10:15	15:20	1:36								
NumberMale	11	11	11	8	10	7	6				
NumberFem	11	12	16	10	7	4	0				
Observer	LCC	LCC	LCC	MM	MM	TDS	TDS				
L		1	8					Total Lecture	11	1%	
LWR	12	12	16			16	9	Total LWR	194	18%	
D								Total Demo***	21		
DI	5	3	8	3	8	1	1	Total D/I ***	146		
TL				4	31	7	8	Total TL	108	10%	
TSP						10		Total TSP	18	2%	
IW		5	3		2	7	5	Total IW	257	24%	
CD			2	15	17			Total CD***	98		
SSP			3		5		11	Total SSP	183	17%	
PS	12	19	7		2		2	Total PS	157	15%	55
SSS		12	1					Total SSS	140	13%	45
O	16	8	3	5			9	Total Other***	207		
Total time	**45**	**59**	**43**	**27**	**65**	**41**	**45**	**Total Time**	**1540**	**100%**	
	49.0			**44.5**				**Adjusted Total Time**	**1068**		
Rom2	2	3	2	3	3	1	3				
Rom3	2	4	3	0	1	1	2				
Rom5	0	3	2	1	2	1	2				
Rom6	0	2	2	1	2	1	2				
Rom7	0	2	0	2	2	1	2				
Rom9	2	2	0	2	1	2	0				
AVERAGE	**1.0**	**2.7**	**1.5**	**1.5**	**1.8**	**1.2**	**1.8**				
District AVE	**1.7**			**1.6**							

Activity Codes

L	lecture
LWD	lecture with discussion
D	demonstration
DI	directions/instructions
TPS	teacher led problem solving
TSP	teacher solving problems
IW	individual work
CD	class discussion
SSP	small group solving problems
SPS	small problem solving groups
SSS	student strategy sharing
O	other

Romberg Observational Scale

Rom 2. The lesson fostered the development of conceptual understanding. (1-4)

Rom 3 Connections within mathematics were explored in the lesson. (1-5)

Rom 5 Students explained their responses or solution strategies. (1-3)

Rom 6 Multiple strategies were encouraged and valued. (1-5)

Rom 7 The teacher valued students' statements about mathematics and used them to build discussion or work toward shared understanding for the class. (1-5)

Rom 9 The teacher encouraged students to reflect on the reasonableness of their responses. (1-5)

Appendix E: Cross Case Data Tables

Table 7. Curriculum training and professional development

	District								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Count**
Initial training	✓	✓	✓	✓	✓	✓	✓	✓	**8**
Brief follow-up training during the year		✓	✓	✓	✓		✓	✓	**6**
Extended follow-up training		✓					✓		**2**
Mentors		✓				✓	✓		**3**
Parent education	✓	✓	✓		✓			✓	**5**
Teachers given preparation time			✓						**1**
Common time for teachers to meet and interact	✓	✓	✓		✓	✓	✓	✓	**7**
Organized consultation and support from district and/or school	✓	✓	✓	✓	✓			✓	**6**
Budget for professional development			✓			✓	✓		**3**

Source: On site interviews conducted by CAREI staff in the fall of 2000.
Key: ✓ = Evidence that category of action or behavior was present in the district.

Table 8. Adoption steps

	District								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Count**
Piloted curriculum		✓	✓						**2**
Needs assessment survey							✓		**1**
Formed curriculum committee (teachers only)	✓	✓	✓	✓	✓			✓	**6**
Formed curriculum committee (teachers, parents, principal, and community)						✓	✓		**2**
Discussions with textbook representatives (phone/conferences)	✓			✓				✓	**3**
Textbook representative visit		✓							**1**
Textbook representatives provided materials			✓						**1**
State and SciMathMN assisted schools			✓						**1**
Teachers received additional training on process						✓			**1**
Teacher visits from other implementing districts	✓	✓			✓				**3**
Visits to implementing classrooms/schools	✓		✓	✓	✓			✓	**5**
Schools narrow curriculum selection						✓	✓		**2**
Adoption decision at the school level	✓	✓	✓	✓	✓	✓	✓	✓	**8**

Source: On site interviews conducted by CAREI staff in the fall of 2000.
Key: ✓ = Evidence that category of action or behavior was present in the district.

Table 9. Major implementation issues or concerns

				District					
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Count**
TEACHERS									
On-going professional development must remain a priority	✓	✓	✓	✓	✓	✓		✓	7
Some key staff not involved in training or implementation process	✓		✓	✓	✓	✓		✓	6
Concerns regarding student assessment	✓	✓		✓		✓	✓	✓	6
Common time for teachers to communicate and collaborate	✓	✓	✓	✓	✓			✓	6
Time and workload	✓				✓	✓	✓	✓	5
Realization that implementation takes time	✓	✓	✓					✓	4
Concern that full implementation not occurring/lack of consensus			✓		✓	✓		✓	4
External funds provided additional support	✓	✓				✓	✓		4
District needs to purchase all materials (including calculators)	✓	✓						✓	3
Major change in instructional practice	✓				✓			✓	3
Teachers supplement curriculum		✓		✓			✓		3
Dual track system has raised concerns			✓		✓	✓			3
Materials were not available at start of school		✓			✓			✓	3
Teacher leaders supported implementation						✓	✓	✓	3
Need for ongoing evaluation of curriculum's impact		✓	✓						2
Teachers want to maintain flexibility in the classroom		✓							1
Concern regarding a lack of administrative support/buy in			✓						1
Teachers struggling to get through curriculum							✓		1
RELATING TO STUDENTS									
Students with LEP and low achievers experience more difficulty	✓	✓		✓		✓		✓	5
Students struggling to adjust to changes	✓				✓		✓		3
Concerns about student test scores		✓			✓				2
Demands for increased student responsibility for learning	✓								1
RELATING TO PARENTS									
District lacks plan for systematically addressing parent concerns	✓	✓	✓	✓	✓			✓	6
Parents do not know how to help children	✓	✓				✓		✓	4
Parents do not know how curriculum will help students			✓	✓	✓		✓		4
Parents concerned about children's ability to apply knowledge	✓	✓						✓	3
Parents of high potential students are concerned about preparation		✓					✓		2

Source: On site interviews conducted by CAREI staff in the fall of 2000.
Key: ✓ = Evidence that category of action or behavior was present in the district.

Appendix F: References

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